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Report on Energy and Nutrient Intakes

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British Columbia Nutrition Survey
Report on Energy and Nutrient Intakes

March 2004

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Executive Summary

The B.C. Nutrition Survey (BCNS), conducted in 1999, is a study by Health Canada and the B.C. Ministry of Health Services, in association with University of British Columbia, to obtain comprehensive up-to-date information on the eating habits of adult British Columbians. One thousand eight hundred and twenty-three (1823) British Columbians participated in the survey, aged from 19 to 84 years. The province-wide survey involved ninety-minute, in-home interviews by trained public health nurses and nutritionists utilizing several questionnaires to assess food consumption and nutrition concerns. The questionnaires included a 24-hour recall, a food frequency questionnaire and a general nutrition questionnaire focusing on physical activity, healthy weight and body image and food security. Socio-demographic information and body measures were also collected.

The purpose of the B.C. Nutrition Survey was to obtain information on the eating habits of adult British Columbians in order to answer key questions about the nutritional health of the adult population. The specific objectives were:

1. To measure food consumption.
2. To determine the contribution of major food groups, food types and dietary supplements to the diet.
3. To determine the distribution of nutrients in the diet.
4. To determine age, gender, education, income and geographic differences in nutrient intake and food consumption.
5. To assess food security, body weight and physical activity.

Several reports were prepared to disseminate the findings of the BCNS. This report is the first of a series of reports from the BCNS and focuses on the energy and nutrient intakes from food and from food plus supplements. It also presents selected data on food security and on Body Mass Index (BMI). Four additional reports on physical activity and body weight, on food and food group use, on supplement use and on seniors' issues will complete the series.

Estimates of usual nutrient intakes in this report represent intakes from food sources as well as supplements. The key findings reported in this document are highlighted here.

The response rate for the BCNS was between 42%-52%, a rate that is comparable to other federal/provincial nutrition surveys. A comparison of BCNS respondents to non-respondents and the general B.C. adult population was made to determine how representative the results would be to the adult population. Overall, the study participants have attained a higher level of education and may have been slightly more health- and/or nutrition-conscious than the non-respondents, as well as the general adult population in B.C.

Median usual intakes for reported food energy were slightly below estimates of requirements for most age-sex groups. However, since more than 50% of the adult population were classified as overweight (BMI=25-29.9) or obese (BMI≥30), it appears that energy levels are likely underreported. The high prevalence of overweight and obesity is a significant public health problem in B.C.

Most British Columbians fell in the acceptable macronutrient distribution ranges for carbohydrates (45-65%), total fat (20-35%) and protein (10-35%).

Even though most British Columbians fell within the acceptable range for total fat, about one-quarter were still consuming more than 35% of their energy from fat. In addition, half of the population was consuming less than 5% of their calories from polyunsaturated fats and more than 10% of their calories from saturated fat.

Two-thirds of British Columbians consumed supplements, including nutritional and non-nutritional supplements. The major supplements taken, in descending order, were a combination of vitamins and minerals, vitamin C, vitamin E and various natural and herbal types. Nutritional supplement use greatly increased with age. Nutritional supplements played an important role in decreasing the proportion of those with inadequate intakes of several nutrients, indicating future dietary guidance must consider the contribution of both food and supplements together.

Geographic strata and income level did not affect intakes of nutrients for which inadequate intakes were a concern. Of these nutrients, educational attainment only effected the intakes of vitamins C and B12.

Food insecurity was reported by 14% of the population.

Overall, British Columbians had adequate usual intakes of thiamin, riboflavin, niacin and phosphorus.

A high percentage of the population had inadequate usual intakes of folate, vitamin B12, vitamin B6, vitamin C, magnesium and zinc, thereby identifying these nutrients as public health concerns. Excessive usual intakes of synthetic niacin from supplements were identified across all age-sex groups, making this an issue for future monitoring.

Median usual intakes of fibre and calcium were below recommendations in most age/sex groups.

Inadequate usual intakes of iron were only a concern for premenopausal women.

The nutrient intake along with the food consumption information from the BCNS will be helpful nationally and provincially to assess the diets of the population; to target, plan and evaluate nutrition intervention programs; and to establish dietary recommendations, food regulations and nutrition policies. The BCNS created a provincial database of food consumption and nutrient intakes that will serve as a baseline for future nutrition surveillance activities. Ultimately, the BCNS information will help to assess progress towards attaining the Provincial Health Goals and Objectives of encouraging healthy eating, physical activity and healthy body weight; reducing nutrition-related chronic illnesses, such as cardiovascular disease, osteoporosis, diabetes and some cancers; and ensuring access to adequate and nutritious foods (B.C. Ministry of Health, 1997).

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1.0 Introduction

1.1 Background

Nutrition is a vital contributor to a healthy population. Nutrition interventions that promote and support the public's health require a strong evidence base of up-to-date nutrition surveillance information. Effective and appropriate health decision-making depends on the ability to measure and monitor food consumption and its linkages to the risk factors for disease and the determinants of health.

The B.C. Nutrition Survey (BCNS), conducted in 1999, investigated the nutrition and health practices of adult British Columbians. The last time a similar nutrition survey was conducted in B.C. was three decades ago. Information from the Nutrition Canada Survey, conducted in 1972, is grossly out of date.

In the intervening years, the food supply has changed dramatically, with many new foods becoming available on the market. Food consumption patterns have changed as well. More than ever, people are eating away from home, enjoying foods from many cultures and embracing dietary supplements and herbal remedies. Public interest in food and nutrition is high. Yet, overweight and dieting are now commonplace. Recently, food insecurity due to poverty has become a concern for many individuals and families. For seniors, food insecurity, combined with chronic debilitating conditions and social isolation, presents even greater challenges to healthy eating (National Institute of Nutrition, 1997).

Good nutrition prevents many immediate and long-term health problems. Poor nutrition ranks along side tobacco use as a risk factor for the chronic diseases that jeopardize population health and burden the health system in British Columbia. Thirty percent of cancer and diabetes and twenty percent of cardiovascular disease are attributable to poor nutrition (Frazao, 1999).

Nutrition surveillance information is required to inform and evaluate health promotion policies and programs to improve the nutritional health of British Columbians. Decision makers in many aspects of public health, including nutrition, toxicology, chronic disease prevention and health promotion, will use information from the BCNS. The BCNS builds the capacity for targeting resources and measuring health outcomes related to nutrition.

1.2 Overview of the B.C. Nutrition Survey

The BCNS is a study by Health Canada and the B.C. Ministry of Health Services, in association with the University of British Columbia, to obtain comprehensive up-to-date information on the eating habits of adult British Columbians. Similar provincial nutrition surveys have been conducted in all other provinces beginning in 1988 with the Nova Scotia Nutrition Survey.

The province-wide survey involved ninety-minute, in-home interviews by trained public health nurses and nutritionists utilizing several questionnaires to assess food consumption and priority nutrition concerns. The questionnaires included a 24-hour recall, a food frequency questionnaire and a general nutrition questionnaire focusing on physical activity, healthy weight and body image and food security. Socio-demographic information and body measures were also collected from 1823 participants, aged 19 to 84 years.

1.3 Purpose and Goals of the B.C. Nutrition Survey

The purpose of the BCNS was to obtain information on the eating habits of adult British Columbians in order to answer key questions about the nutritional health of the adult population.

The food consumption and nutrient intake information from the BCNS is needed nationally and provincially to assess the diets of the population; to target, plan and evaluate nutrition intervention programs; and to establish dietary recommendations, food regulations and nutrition policies. The information will also be used to make assessments of the risk of exposure to contaminants or potentially toxic elements in the food supply. The BCNS created a provincial database of food consumption and nutrient intakes that will serve as a baseline for future nutrition surveillance activities.

Ultimately, the BCNS information will help assess progress towards attaining the Provincial Health Goals and Objectives of encouraging healthy eating, physical activity and healthy body weight; reducing nutrition-related chronic illnesses, such as cardiovascular disease, osteoporosis, diabetes and some cancers; and ensuring access to adequate and nutritious foods (B.C. Ministry of Health, 1997).

The specific goals of the BCNS were:

1. To measure food consumption.
2. To determine the contribution of major food groups, food types and dietary supplements to the diet.
3. To determine the distribution of nutrients in the diet.
4. To determine age, gender, education, income and geographic differences in nutrient intake and food consumption.
5. To assess food security, body weight and physical activity.

1.4 Contents of the Reports on the B.C. Nutrition Survey

The findings of the BCNS are presented in five reports. These reports are key to moving ahead provincial and national nutrition agendas. This report, the *Report on Energy and Nutrient Intakes*, focuses on the energy and nutrient intakes from food and from food plus supplements. It also presents selected data on food security and on Body Mass Index. Four additional reports describe (1) food group use, (2) seniors' nutrition and health issues, (3) physical activity and body weight and (4) supplement use.

The goals of the BCNS can be addressed through review and reporting of the results of the 24-hour recall, general health and nutrition questionnaire, demographic data and anthropometric data. Therefore, the results of the food frequency questionnaire are not reviewed and reported in any of the reports of the BCNS.

The literature review, the methodology and the results related to response rate and the demographic data of the sample are presented only once in this *Report on Energy and Nutrient Intakes*.

2.0 Literature Review

2.1 Introduction

The purpose of this literature review is to provide background on issues relevant to the British Columbia Nutrition Survey. A major focus of this document is thus to review existing data on food and nutrient intakes and food-related behaviours of British Columbians. In addition, literature on risk factors addressed in the B.C. Nutrition Survey is reviewed, including obesity, poor body image and disordered eating, physical inactivity and food insecurity. Because survey participants were age 19 to 84, data obtained from this age group form the focus of the review and because seniors (up to age 84) were over-sampled, information pertaining to this age group is also presented. Whenever possible, B.C.-specific data are cited.

2.2 Food and Nutrient Intakes

Data on food and nutrient intakes can be obtained through dietary surveys, in which individuals recall or record their food intakes on one or more days and through food disappearance data. Both have limitations: Food records or recalls appear to be subject to an underreporting bias (Black et al, 1993; Briefel et al, 1997; Howat et al, 1994; Mertz et al, 1991; Trabulsi and Schoeller, 2001) and thus underestimate true intakes, while food disappearance data do not account for food wastage and may thus overestimate true intakes. Nevertheless, both can provide an indication of average intakes and may allow inferences about changes over time.

2.2.1 Dietary Surveys

2.2.1.1 Nutrition Canada

The only previous comprehensive nutrition survey completed in B.C. was the Nutrition Canada Survey, conducted between 1970 and 1972 (Nutrition Canada, 1973, 1975a, 1975b). That survey obtained information on food and nutrient intakes of infants, children aged 1-4 and 5-11, adolescents 12-19 and adults 20-39, 40-64 and 65 and above. Nutrient intake data represented intakes from both food and supplements and intakes were compared to standards developed for use in the survey. It should be noted that these standards differed from recommendations in the Dietary Standard for Canada at the time of the survey and also differed from current Recommended Nutrient Intakes and Dietary Reference Intakes (Health and Welfare Canada, 1990; Institute of Medicine 1997, 1998, 2000a, 2001). It should also be noted that different survey reports used different methods to assess the intake

adequacy for various age/sex groups. In the provincial reports (Nutrition Canada, 1975b), which also present the national data, adequacy was assessed by comparing median intakes to the standards and classifying the median intake as adequate, marginal or inadequate. Although these reports also tabulate percentiles of the distribution of intakes (i.e., 5th, 25th, 50th, 75th and 95th), these were not considered in the assessments. As a result, conclusions drawn must be interpreted with caution: Although median intake may have been adequate (and thus intakes for the group assessed as "adequate"), a substantial proportion of the group could have inadequate intakes. Nevertheless, the median and mean intakes do provide data for comparison purposes. In contrast, in *Nutrition: A National Priority* (Nutrition Canada, 1973) the proportions of each age/sex group with intakes that were "inadequate" or "less than adequate" are tabulated separately and, in many cases, the assessments of adequacy are different than when median values are compared to the standards.

2.2.1.1.1 Assessment of median intakes.

Median and mean nutrient intakes for men and women aged 20-39, 40-64 and 65 and above (total n = 6767) are shown in Table 2.1.

Table 2.1 Median and mean intakes[1] from food and supplements of adults in the Nutrition Canada Survey, 1970-72

Nutrient	**Men**			**Women**		
	20-39 yr	**40-64 yr**	**≥65 yr**	**20-39 yr**	**40-64 yr**	**≥65 yr**
Energy (kcal)	3188/3374	2465/2671	1902/2056	1933/2001	1653/1726	1479/1530
Protein (g)	110.5/119	85.0/94	67.2/72	66.6/72	59.6/63	49.3/54
Fat (g)	- /154	- /118	- /89	- /89	- /75	- /63
Carbohydrate (g)	- /351	- /286	- /235	- /227	- /197	- /187
Thiamin (mg)	1.46/1.57	1.21/1.32	1.05/1.08	0.96/1.02	0.88/0.90	0.80/0.85
Riboflavin (mg)	2.20/2.59	1.80/2.09	1.50/1.77	1.50/1.70	1.30/1.49	1.20/1.47
Niacin (mg NE)	45.5/48	34.9/37	25.5/28	26.2/28	24.1/25	20.1/21
Vitamin C (mg)	94/118	81/101	67/85	70/89	81/106	79/87
Vitamin A (mcg)	1123/1551	1061/1332	823/1113	793/1292	688/1031	708/1008
Calcium (mg)	957/1081	777/883	600/709	587/709	537/613	518/619
Vitamin D (IU)	108/ -	108/ -	101/ -	80/ -	75/ -	95/ -
Iron (mg)	17.3/18	14.3/16	12.5/13	11.1/12	10.8/11	9.4/10

Source: Nutrition Canada 1975a, 1975b.

[1] Values are presented as median/mean.

Only means are shown; median values were not reported.

Only medians are shown; mean values were not reported.

Major findings for the national sample included the following: Median caloric intakes, particularly of women and older adults, were lower than generally accepted standards, yet this was accompanied by a high prevalence of high-risk Ponderal Index values (the measure of relative weight used in the survey). Protein intakes were generally adequate, but median intakes in senior women were close to the marginal range. Intakes of thiamin, riboflavin and niacin were adequate in most adults, although some low values were observed in the elderly. Vitamin C intakes were low in elderly men, while vitamin A intakes were close to the marginal range in 40-64 year old women and in both men and women 65 and above. Calcium intakes were reported to be adequate in adults up to age 64, but were low in senior adults, for whom vitamin D intakes were also a concern. Low iron intakes were a concern for menstruating women and for senior men.

True mean and median values for percentage energy distribution from protein, fat and carbohydrate were not reported in the Nutrition Canada survey. However, approximate estimates can be derived by dividing mean intakes from each macronutrient by mean total energy intakes. These values, presented in Table 2.2, suggest that dietary fat provided approximately 40% of energy, protein about 14% and carbohydrate about 42-46%.

Table 2.2 Estimated mean percentage of energy derived from protein, carbohydrate and fat, Nutrition Canada Survey, 1970-72

Macronutrient	**Men**			**Women**		
	20-39 yr	**40-64 yr**	**≥65 yr**	**20-39 yr**	**40-64 yr**	**≥65 yr**
Protein	14.1	14.1	14.0	14.4	14.6	14.1
Fat	41.1	39.8	39.0	40.0	39.1	37.1
Carbohydrate	41.6	42.8	45.7	45.4	45.6	48.9

Derived from Nutrition Canada, 1975a.

2.2.1.1.2 Assessment of the distribution of intakes.

Table 2.3 reports the proportions of adults aged 20-39, 40-64 and 65 and above with intakes that were assessed as "inadequate" or "less-than-adequate".

Table 2.3 Proportions of intakes classified as "inadequate" or "less than adequate", Nutrition Canada Survey, 1970-72

Nutrient	Cut-points	Men			Women		
		20-39 yr	40-64 yr	≥65 yr	20-39 yr	40-64 yr	≥65 yr
Protein							
Inadequate	<0.5 g/kg	1.6	7.2	7.1	9.2	11.1	14.5
Less-than-adequate	0.5-0.7 g/kg	7.4	5.6	20.2	8.8	15.9	23.2
Iron							
Inadequate	<6, <10 mg	3.8	3.5	4.9	37.7	30.7	8.4
Less-than-adequate	6-10, 10-15 mg	11.5	14.8	30.0	38.4	36.1	47.5
Calcium							
Inadequate	<300 mg	8.6	4.4	9.9	19.3	17.8	20.0
Less-than-adequate	300-500 mg	13.2	18.4	22.4	22.3	26.1	27.8
Vitamin A							
Inadequate	<500 RE	14.3	15.1	23.1	24.4	29.6	32.1
Less-than-adequate	500-750 RE	12.9	15.2	22.9	22.4	25.4	21.6
Vitamin C							
Inadequate	<10 mg	3.5	3.4	4.0	5.8	4.2	1.9
Less-than-adequate	10-30 mg	11.0	10.3	12.8	14.8	12.4	11.2
Thiamin							
Inadequate	<0.5 mg	7.7	7.6	10.7	11.9	16.1	14.5
Less-than-adequate	0.5-0.8 mg	34.8	32.8	29.9	35.9	33.7	18.3
Riboflavin							
Inadequate	<0.6 mg	5.2	2.9	4.3	8.8	11.6	14.8
Less-than-adequate	0.6-1.1 mg	27.0	27.3	36.8	33.0	36.9	32.8
Niacin							
Inadequate	<8.8 NE[4]	1.6	1.4	1.6	1.1	3.6	4.7
Less-than-adequate	8.8-13.2 NE[4]	0.3	3.2	7.2	8.2	7.4	14.1

Source: Nutrition Canada, 1973.

Lower values for men and postmenopausal (>55 yr) women, higher values for menstruating women.

Values shown are for diets <2000 kcal. For diets over 2000 kcal, cut-points are <0.25 mg/1000 kcal and 0.25-0.4 mg/1000 kcal.

Values shown are for diets <2000 kcal. For diets over 2000 kcal, cut-points are <0.3 mg/1000 kcal and 0.3-0.55 mg/1000 kcal.

[4] Values shown are for diets <2000 kcal. For diets over 2000 kcal, cut-points are <4.4 NE/1000 kcal and 4.4-6.6 NE/1000 kcal.

For many nutrients, this leads to noticeably different assessments than those reported above based on median intakes. Specifically, over 30% had "inadequate" or "less-than-adequate" intakes as follows: Protein in senior women, iron and calcium in all women and senior men, vitamin A in all groups except young men and thiamin and riboflavin in all groups. It should be noted that the methodology used for obtaining intake distributions in the Nutrition Canada survey (a single 24-hour recall) results in an intake distribution that is much broader than if repeat measurements are made on a subset of individuals and the data adjusted for day-to-day variability (i.e., on any given day, individuals may have unusually low or unusually high intakes, leading to distributions with long 'tails' at the lower and upper ends. Adjusting for day-to-day variability, as is now the standard, "tightens" the distribution and leads to lower proportions of individuals in the "tails" of the distribution.) With unadjusted distributions, assessing the proportion of individuals below certain cut-points can lead to overestimates (Institute of Medicine, 2000b; Nusser et al. 1996). Thus, the percentages presented in Table 2.3 also need to be interpreted cautiously.

2.2.1.1.3 Assessment of intakes of British Columbians

Mean values for nutrient intakes of adult British Columbians who participated in the Nutrition Canada survey are presented in Table 2.4. Few major differences from national data were observed, although energy intakes of those aged 20-39 and 65 and above tended to be lower than national means.

Table 2.4 Mean nutrient intakes of British Columbia adults, Nutrition Canada Survey, 1970-72

Nutrient		**Men**			**Women**	
	20-39 yr	**40-64 yr**	**≥65 yr**	**20-39 yr**	**40-64 yr**	**≥65 yr**
Energy (kcal)	3071	2590	1925	1762	1743	1422
Protein (g)	109	95	71	67	68	54
Fat (g)	135	116	80	77	76	58
Carbohydrate (g)	324	269	227	198	198	173
Thiamin (mg)	1.42	1.20	1.07	0.92	0.97	0.83
Riboflavin (mg)	2.60	2.17	1.80	1.56	1.68	1.39
Niacin (mg NE)	44	38	28	26	28	20
Vitamin C (mg)	106	98	98	78	100	83
Vitamin A (mcg RE)	1363	1890	1016	1036	1062	772
Calcium (mg)	1143	905	789	676	709	641
Total folate (mcg)	211	186	159	142	154	131
Iron (mg)	18	16	13	11	12	10

Source: Nutrition Canada, 1975a.

2.2.1.2 Food Habits of Canadians

In 1997-1998, a national survey of adult Canadians aged 18-65, 1502 of whom were aged 20-64, was undertaken, again using 24-hour recall methodology to estimate mean energy and nutrient intakes (Gray-Donald et al. 2000). In the initial analysis of the data, intakes from nutrient supplements were not considered, so the nutrient intake data are not strictly comparable to the data from the Nutrition Canada survey. Possible limitations of the study include a low response rate and the possibility that the tendency to under-report food intake may have increased since the time of the Nutrition Canada survey. Nevertheless, the data, presented in Table 2.5, suggest that considerable changes have occurred in dietary intakes during the last three decades.

Table 2.5 Energy and nutrient intakes of Canadians, Food Habits of Canadians Survey, 1997-98

Nutrient	**Men**		**Women**	
	20-39 yr	**40-64 yr**	**20-39 yr**	**40-64 yr**
Energy (kcal)	2918	2464	1869	1749
Protein (g)	123	104	75	75
Fat (g)	98	84	63	58
Thiamin (mg)	2.57	2.23	1.58	1.70
Riboflavin (mg)	2.70	2.27	1.68	1.67
Niacin (mg NE)	52	46	33	32
Vitamin C (mg)	204	134	143	132
Vitamin A (mcg RE)	2018	1854	1462	1832
Calcium (mg)	1177	896	781	745
Total folate (mcg)	322	301	239	241
Iron (mg)	21	17	14	13

Source: Gray-Donald et al, 2000.

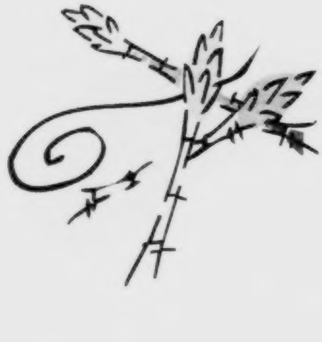
In most cases, reported energy intakes were lower than in the past and this was associated primarily with a decrease in the intake of fat, to an average of about 30% compared to the 40% of energy observed by Nutrition Canada. Protein intakes were stable in adults aged 20-39, but increased by about 10 g/day in adults aged 40-64. Intakes of most vitamins and minerals were also higher, which is particularly noteworthy since the Nutrition Canada data included supplement use and the reported values from the Food Habits of Canadians survey did not. Given the lower reported energy intakes, it appears that the nutrient density of the diet has improved. Possible mechanisms include an increase in the intakes of fortified foods, as well as change in dietary patterns themselves (for example, increased intakes of fruits, vegetables and whole grains).

2.2.1.3 Other Studies of British Columbians

Other studies reporting energy and nutrient intakes of subgroups of British Columbians (e.g., vegetarian and nonvegetarian women, women with high and low levels of cognitive dietary restraint, women aged 85 and above living in an extended care facility) have been published (Barr and Broughton, 2000; Janelle and Barr, 1995; Barr et al, 1983; Barr et al, 1984; Barr 1993, McLean et al, 2001). These data will not be discussed in detail here because the samples were convenience samples, rather than representative population samples. However, the studies of vegetarian and nonvegetarian women will be summarized briefly because of the apparent growing prevalence of a vegetarian dietary pattern, particularly among women. Furthermore, vegetarianism appears to be more common in B.C. than in the rest of Canada: the Tracking Nutrition Trends survey found that 8.5% of British Columbians are vegetarian, compared to a national average of 3.7% (Canadian Facts and National Institute of Nutrition, 1997).

2.2.1.3.1 Studies of vegetarian women.

Two studies of vegetarian women in the Lower Mainland area of British Columbia have been completed. In the first, Janelle and Barr (1995) studied 22 nonvegetarian women (who ate red meat 3 or more times per week) and 23 vegetarian women (who had excluded all flesh foods for at least two years). All women were carefully screened. Inclusion criteria included age 20-40, Body Mass Index (BMI; kg/m^2) 18-25, being a nonsmoker, exercise of < 7 hr/wk and alcohol use of < 7 drinks/wk. In the second study, Barr and Broughton (2000) assessed intakes of a broader cross-section of 90 vegetarian and 68 nonvegetarian women. In that study, vegetarian status was self-defined and the only inclusion criterion was premenopausal status. Findings from the two studies were generally similar: In both cases, vegetarians and nonvegetarians reported similar energy intakes and percentage of energy from fat. Diets of both vegetarians and nonvegetarians adhered closely to current nutrition recommendations in terms of macronutrient composition (e.g., <30% fat, <10% saturates) and dietary fibre intake. Vegetarians, however, consistently reported a lower percentage of energy from protein, lower intakes of saturated fat, cholesterol, niacin, vitamin B12 and vitamin D and higher intakes of fibre. Zinc intakes tended to be lower among vegetarians. Vegetarians' vitamin B12 and vitamin D intakes were well below current recommendations.



2.2.1.4 Recent Changes to Nutrient Intake Recommendations

Another challenge in interpreting nutrient intake data, vis-à-vis their implications for population level interventions, is related to the standards to which nutrient intakes are compared. Until recently, the Recommended Nutrient Intakes (RNIs) represented the nutrient intake goals for the Canadian population. Beginning in 1997, however, the RNIs have been undergoing revision as part of a joint Canada/U.S. initiative to harmonize nutrient intake recommendations. The new recommendations, termed Dietary Reference Intakes (DRIs), include the Estimated Average Requirement (EAR), the Recommended Dietary Allowance (RDA), the Adequate Intake (AI) and the Tolerable Upper Intake Level (UL). To date, DRIs have been released for calcium and related nutrients (Institute of Medicine, 1997), B vitamins (Institute of Medicine, 1998), antioxidants (Institute of Medicine, 2000), micronutrients (Institute of Medicine, 2001) and energy and macronutrients (Institute of Medicine, 2002).

The intakes recommended for individuals are presented as either an RDA or an AI. The RDAs are set at two standard deviations above the Estimated Average Requirement for nutrients with normally distributed requirements or at the 97.5th percentile of the requirement distribution for nutrients with skewed distributions. AIs are established when there is insufficient data to establish an EAR from which an RDA can be estimated, but represent a level of intake thought to exceed the requirements of almost all healthy individuals. Thus, both RDAs and AIs represent recommendations for intakes by individuals to minimize the risk of nutrient inadequacy. For those nutrients with EARs, the proportion of the population with inadequate intakes can be quantitatively estimated as the proportion with intakes below the EAR (Institute of Medicine, 2000b). For nutrients with an AI, the prevalence of nutrient inadequacy cannot be quantitatively determined.

For several nutrients, the new recommendations are considerably higher than the 1990 RNIs. For several nutrients the implications are particularly strong for older adults. As an example, Table 2.6 compares the 1990 RNIs for selected nutrients to the new RDA or AI for adults age 50 and above and indicates that recommendations for calcium, magnesium, vitamin D, folate, vitamin B12, vitamin C and vitamin E have increased by 50% to 200%. Many of these nutrients are consumed in marginal amounts by older adults; thus, higher recommendations suggests that even larger proportions will be at potential risk. The new recommendations also impact on other age groups. The most notable of these include calcium, magnesium, folate, vitamin E and for menstruating women, iron.

Table 2.6 Comparison of 1990 RNIs to new RDAs or AIs for adults aged over 50

Nutrient	RNI[1]		RDA/AI[2]	
	Men	**Women**	**Men**	**Women**
Calcium (mg/d)	800	800	1200	1200
Magnesium (mg/d)	250 (230)	210	420	320
Vitamin D (mcg/d)	5	5	10 (15)	10 (15)
Fluoride (mg/d)	in water	in water	4	3
Vitamin B_6 (mg/d)	0.9-1.5[3]	0.8 – 1.1[3]	1.7	1.5
Folate (mcg DFE/d)	230 (215)	195 (200)	400	400
Vitamin B_{12} (mcg/d)	1.0	1.0	2.4[4]	2.4[4]
Choline (mg/d)	N/A	N/A	550	425
Vitamin C (mg/d)	40	30	90	75
Vitamin E (mg/d)	7 (6)	6 (5)	15	15
Vitamin A (RAE/d)	1000 RE	800 RE	900[5]	700[5]

[1] Values shown are 1990 RNIs for adults aged 50-74. Values for those aged 75 and above are shown in parentheses when they differ from values for those aged 50-74.

[2] Values shown are RDAs or AIs for adults aged 51-70. Values for those aged 71 and above are shown in parentheses when they differ from values for those aged 51-70.

[3] The RNI for vitamin B6 was expressed as 0.015 mg/g protein. Values shown represent a range of protein intakes from the RNI to 100g/d for men and 70 g/d for women.

[4] It is advisable for those older than 50 years to meet their RDA mainly by consuming foods fortified with B12 or with a supplement containing B12.

[5] The bioavailability of dietary carotenoids is now estimated to be only 50% of that estimated in the 1990 RNI. Thus, individuals who rely on plant sources of vitamin A will need to consume substantially larger amounts (effectively, twice as much) to meet the new recommendations.

2.2.2 Food Disappearance Data

2.2.2.1 Food Consumption in Canada

National data on apparent food consumption is produced using a supply-disposition approach (Statistics Canada, 1997a). To calculate total supply, the amounts produced and imported during the year are added to stocks available at the beginning of the year. The net supply (i.e., that available for consumption) is determined by subtracting stock at the end of the year, exports, manufacturing uses, livestock feed and (occasionally) waste during processing. The waste factors, however, do not account for losses in stores, households, private institutions or restaurants. The net supply is divided by the Canadian population at July 1 of a given year to determine per capita food availability for that year.

Data on per capita disappearance of major food groups are available between the years of 1961 and 1996 (Statistics Canada, 1997b) and thus permit inferences to be made about changes in the food supply over that time period. For the purpose of this report, the most relevant changes are likely those that occurred between the time of the Nutrition Canada Survey (1970-72) and now. Table 2.7 shows these data for major food

Table 2.7 Changes in per capita food disappearance, 1970-72 versus 1994-96

Food Group	Disappearance 1970-1972	Disappearance 1994-1996	Net change (kg or L)	Percent change
Fruits (kg)	84.92	122.65	37.73	44.4
Vegetables (kg)	142.69	178.19	35.50	24.9
Oils and fats (kg)	20.69	25.71	5.02	24.2
Cereals (kg)	66.65	78.19	11.54	17.3
Alcoholic beverages (L)	123.94[1]	96.99[1]	(26.95)	(21.7)
Soft drinks (L)	60.28[2]	77.55	17.27	28.6
Fluid milk (L)	95.59	89.23	(6.36)	(6.6)
Cheese (kg milk solids)	5.58	11.44	5.86	105
Total dairy products (kg milk solids)	25.16	23.44	(1.72)	(6.8)
Red meat (kg)	75.85	60.87	(14.98)	(19.7)
Poultry (kg)	19.62	30.72	11.1	56.6
Eggs (dozen)	20.93	14.65	(6.28)	(30.0)
Pulses and nuts (kg)	7.52	8.35	0.83	11.0
Sugar (kg)	45.4	39.93	(5.47)	(12.0)

Source: Statistics Canada, 1997b. Negative values are shown in parentheses.

[1] For population aged 15 and above.

[2] Data are not reported for 1970 and 1971, thus, disappearance is for 1972-1974.

groups and indicates that apparent consumption of fruit, vegetables, oils and fats, cereals, poultry and pulses and nuts have increased, while alcoholic beverages, red meat and eggs have decreased. Small changes were observed in dairy product and sugar disappearance. These changes are generally consistent with the changes in nutrient intake observed between the 1970-72 Nutrition Canada Survey and the 1997-98 Food Habits of Canadians Survey.

2.3 Food and Nutrition Behaviours

In addition to the quantitative data available on food and nutrient intakes, a number of studies have reported on consumers' nutrition-related knowledge, attitudes and self-reported behaviour. The most prominent of these are the Heart Health Surveys (Ministry of Health, Province of B.C. and Health and Welfare Canada, 1990), Tracking Nutrition Trends (Canadian Facts and National Institute of Nutrition, 1997), the National Population Health Survey (Hooper, 1996) and the Canadian Community Health Survey (Statistics Canada Health Indicators, 2002), which will be discussed below.

2.3.1 Heart Health Surveys

Although the mortality rate from cardiovascular disease in Canada has been declining since the mid-1960s (Heart and Stroke Foundation of Canada, 1997a), it nevertheless remains the primary cause of death for Canadians, accounting for 36% of male deaths and 39% of female deaths in 1996 (Federal, Provincial and Territorial Advisory Committee on Population Health, 1999). At that time, the age-standardized mortality rate for cardiovascular disease in British Columbia was the lowest in Canada for both men and women. Despite this observation, that parallels national data for smoking, hypertension and obesity, further improvement is possible and desirable.

Information about the prevalence of cardiovascular disease risk and the level of knowledge and awareness among British Columbians aged 18-74 is available from the British Columbia Heart Health Survey (Ministry of Health, Province of British Columbia and Health and Welfare Canada, 1990). This survey, conducted in 1989, included measurements of height, weight, blood pressure and serum lipids, as well as self-report data on smoking, alcohol consumption, diabetes and physical activity. Knowledge and awareness about dietary factors that affect cardiovascular risk were also assessed. These questions revealed that most British Columbians knew that cholesterol was found in foods and affects health, while fewer were aware of sources of dietary cholesterol other than eggs. When asked an open question about what can a person do to lower their blood lipids, the most common response was to eat foods with less cholesterol (71%) and to eat less fatty foods (52%). The report concluded that there was a need for public education programs to address the need to reduce total and saturated fat intake and that would provide practical guidance for individuals about how this should be done. The survey was conducted prior to the release in 1990 of the *Nutrition Recommendations for Canadians, Canada's Guidelines for Healthy Eating* and *Canada's Food Guide to Healthy Eating*, which provide much of this suggested advice. Whether these resources have affected British Columbians' knowledge and practices cannot be directly assessed, although changes in national food disappearance data suggest that food habits are changing in the desired direction.

2.3.2 Tracking Nutrition Trends

The National Institute of Nutrition, in partnership with member organizations and Agriculture Canada, has commissioned a national survey on the nutrition-related knowledge, attitudes and behaviours of Canadians, particularly as they pertain to fat, fibre and cholesterol (Canadian Facts and National Institute of Nutrition, 1997). Three

waves of the survey have been conducted, in 1989, 1994 and 1997. Objectives for the most recent survey were: 1) to identify recent changes in attitudes, awareness and reported behaviour towards nutrition in general and fat, fibre and cholesterol in particular; 2) to gather baseline data for new issues such as calcium; and 3) to assess awareness of *Canada's Food Guide to Healthy Eating* and level of knowledge of the four food groups. National probability samples were used to survey five geographic regions: B.C., the Prairies, Ontario, Quebec and the Atlantic provinces. Data were weighted to reflect the Canadian adult population. Aspects of the results that may be pertinent to the B.C. Nutrition Survey include information on food and nutrition concerns and on vegetarian dietary practices.

2.3.2.1 Food and Nutrition Concerns

The major food and nutrition related concerns of Canadians are shown in Table 2.8, which shows the percentage of respondents who were "very" or "somewhat" concerned about various issues. The table also shows how the level of concern has changed since 1989 and 1994.

Fat was the issue of concern to the largest proportion of Canadians in 1997, with almost 4 of 5 being "very" or "somewhat" concerned, but more than 50% of respondents were concerned about all issues except caffeine, trans fatty acids and hydrogenation. In most cases, the proportions expressing concern decreased between 1994 and 1997, but remained above 1989 levels (Canadian Facts and National Institute of Nutrition, 1997).

Table 2.8 Percent of Canadians who are "Very/Somewhat concerned" about food and nutrition issues

Food/nutrition issue	Percent of Canadians who are "Very/Somewhat Concerned"		
	1997	Change since 1994	Change since 1989
Fat	79	-3	+8
Food poisoning	70	N/A	N/A
Vitamins	70	-3	+8
Chemical residues	67	-9	-1
Calcium	67	-5	+4
Fibre	66	-7	-1
Saturated fat	66	-5	N/A
Calories/energy	62	-7	+3
Cholesterol	61	-9	+1
Salt/sodium	60	-7	+3
Sugar	57	-9	+1
Iron	53	-9	N/A
Preservatives	52	-10	-2
Trans fatty acids	40	N/A	N/A
Hydrogenation	34	-3	+6

Source: Canadian Facts and National Institute of Nutrition, 1997.

Respondents who were "very" or "somewhat" concerned about each of fat, cholesterol, fibre and calcium were asked whether they were doing anything to address their concerns. Actions were reported by 95%, 86%, 91% and 88% of those concerned about fat, cholesterol, fibre and calcium, respectively. Among those concerned about fat, reported actions included buying and eating lower fat products (39%), using less fat in food preparation (39%), eating less or avoiding fatty and fried foods (26%), modifying use of fats and oils (21%) and changing consumption of meat and meat alternatives (16%) (Canadian Facts and National Institute of Nutrition, 1997).

The proportion of Canadians considering themselves as "very" or "somewhat" likely to decrease or further decrease their fat intake over the coming months decreased from 46% in 1994 to 33% in 1997. Similarly, the proportions planning to increase or further increase their fibre intake fell from 33% to 23%. In both cases, three-quarters of those who did not plan to change indicated that they were already eating well and had no need to change. Without nationally-representative intake data, it cannot be determined if diets have improved and additional change is not required or whether, having made small changes, the public has become less sensitive to these issues.

2.3.2.2 Vegetarian and Special Diets

Nationally, 3.7% and 11.3% of Canadians responded positively to the statements "I am a vegetarian" and "I follow a special or prescribed diet", respectively (Canadian Facts and National Institute of Nutrition, 1997). These proportions were higher in the B.C. region than in the national sample, with 8.5% of British Columbians reporting that they were vegetarian and 15.1% reporting that they followed a special diet. In both cases, these were the highest among the five regions studied.

Respondents who considered themselves vegetarian reported whether they "ever ate" various foods (see Table 2.9 for national and B.C. data). In general, fewer British Columbians included each food category as compared to the national sample, although comparisons must be made with caution because of the small sample size. Nevertheless, it is clear that self-defined vegetarians have varied dietary practices and that few would be considered vegan vegetarians.

Table 2.9 Percentages of self-defined vegetarians who "ever eat" various foods

	Percentage who report that they "ever eat"	
	National (n=73)	**B.C. (n=23)**
Milk/dairy products	89.5	84.9
Fish or seafood	77.9	76.0
Eggs	70.7	62.6
Chicken/poultry	60.6	49.6
Red meats	19.9	20.3
None of the above	1.4	2.3
At least one of the above	92.5	86.7

Source: Canadian Facts and National Institute of Nutrition, 1997, Table 73.

2.3.2.3 Awareness of Canada's Food Guide to Healthy Eating

All participants in the survey were shown a copy of *Canada's Food Guide to Healthy Eating* and asked whether they ever recalled seeing it before. Sixty-three percent of the national sample reported having seen it, higher than the 58% reported for the B.C. region (Canadian Facts and National Institute of Nutrition, 1997). Before being shown the Guide, participants were asked to provide the names of the four food groups that are promoted in the Guide. Results, shown in Table 2.10, indicate that over half of Canadians could identify all four groups and that almost nine of ten could identify at least one food group. In the B.C. region, the ability to name each of the food groups was consistently lower than for the national sample.

Table 2.10 Percentages of respondents able to identify the four food groups

Food Group	National (n=73)	B.C. (n=23)
Grain/starch	71	67
Meat/protein	81	74
Milk products	75	66
Vegetables and fruit	80	75
Nothing/don't know	12	16
All four food groups	56	42
At least one of four groups	87	83

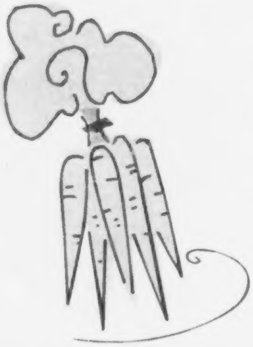
Source: Tracking Nutrition Trends, Table 64.

2.3.3 National Population Health Survey

The National Population Health Survey (NPHS) is a longitudinal survey on Canadians' health (Hooper, 1996). The first wave, for which data are available, was conducted in 1994-95 with 13,400 individuals aged 12 and above. Nutrition questions included asking respondents whether they were eating more of selected food groups than they had 12 months ago and whether they were increasing the amount of starch and fibre and/or decreasing the amount of fat in the foods they ate.

The data indicate that 35.6% of men and 44.8% of women reported increasing their vegetable and fruit intake over the past 12 months. Increased grain product intakes were reported by about 25% of men and 30% of women.

In response to a "yes" or "no" question, 43% of respondents reported that they were concerned about the amounts of starch and fibre in their diets. This was lower than the 66% who were "very/somewhat concerned" in the 1997 Tracking Nutrition Trends (TNT) survey; however, that survey asked individuals whether they were "very", "somewhat", "not too" or "not at all" concerned and the difference in question format may have affected the response. Similar to the TNT survey, however, a majority of those who were concerned reported taking action to increase their starch and fibre intakes. About 80% of both men and women who were concerned about starch and fibre responded "yes" to queries about whether they were eating vegetables or fruit at most meals and were eating whole grain products. Substantial proportions (30%-60%) also indicated that they were eating meals with less meat, choosing foods high in fibre, baking with whole wheat flour and using meat alternatives.



Similar questions were asked in regard to dietary fat. Seventy-six percent of women and 60% of men were concerned about fat and the large majority of those concerned reported taking action to reduce fat intake: approximately four out of five reported that they were "using less butter, oil or salad dressing", "eating less fried or deep fried foods" and "eating leaner meat, poultry and fish". Although women were somewhat more likely to report these changes than men, the proportions were reasonably close. The proportions reporting these changes in the NPHS were notably higher than those reporting similar changes in the TNT study; however, the data cannot be compared because the NPHS asked individuals to respond "yes" or "no" to each change, whereas the TNT survey asked an open question and respondents generated their own responses.

2.3.4 Canadian Community Health Survey

Data are available from the Canadian Community Health Survey (2000/01) on fruit and vegetable consumption among Canadians and British Columbians, in categories of <5 times/day, 5-10 times/day and >10 times/day (Statistics Canada, Health Indicators 2002). The results suggest that the majority of Canadians and British Columbians may not meet the recommendation to consume 5-10 servings a day: Nationally, 61.8 % of individuals aged 12 and above consumed <5 times/day, 33.4% consumed 5-10 times/day and 3.7 % of consumed over 10 times/day. The percentages were similar for B.C., at 60.7%, 34.7% and 2.9%, respectively. There were noticeable trends in fruit and vegetable consumption with age. Nationally, the proportions consuming at least 5 times/day increased from 34.4% among those aged 19-34 to 44.5% among those aged 65 and above and almost identical changes with age were seen in the B.C. sample. Also, women consumed fruits and vegetables more frequently than men. Nationally, the proportions are 4.9 times per day versus 4.2 times per day (Perez, 2002). For B.C., 66.1% of males and 55.5% of females consume fruit and vegetables less than 5 times/day (unpublished data, B.C. Ministry of Health Planning, September 2002).

2.4 Risk Factors

2.4.1 Obesity

2.4.1.1 Definition and Associated Health Risks

The World Health Organization (WHO) currently defines "overweight" as a BMI of 25 or greater and "obesity" as a BMI of 30 or more (World Health Organization, 1998). Canada has used BMI to assess weight status since 1988 (Health and Welfare Canada, 1988). In May 2003, Health Canada released the new Canadian Guidelines for Body Weight Classification in Adults (Health Canada, 2003), which are aligned with the WHO's global weight classification system. Prior to

this release. Canada's guidelines were that a BMI of 20-25 is healthy for most people, that a BMI of 25-27 is associated with increased health risk in some people and that a BMI of 27 or more is associated with increased health risk in most people. Health risks that have been associated with obesity include type 2 diabetes mellitus, coronary heart disease, hypertension, dyslipidemia, sleep apnea, gallbladder disease, liver disease, osteoarthritis, impaired reproductive function and certain forms of cancer (National Task Force on the Prevention and Treatment of Obesity, 2000). Mortality is also increased (Manson et al, 1995; Calle et al, 1999).

2.4.1.2 Costs to the Health Care System

The direct costs related to the treatment of and research into obesity in Canada were recently estimated by Birmingham (Birmingham et al, 1999). Using the medical literature, these authors identified 10 co-morbidities associated with obesity. For each co-morbidity, a population attributable fraction (PAF) was determined, reflecting the extent to which obesity contributed to the condition and its management costs. PAFs ranged from 4.7% for colorectal cancer to 50.7% for type 2 diabetes. Direct costs of each co-morbidity were determined using national data for the costs of hospital care, physician services, services of other health professionals, drugs and health research. The costs attributable to obesity were then estimated by multiplying the total direct costs of each co-morbidity by the PAF. Using this approach, the total direct cost of obesity in Canada in 1997 was estimated to be in excess of $1.8 billion and the three largest contributors were hypertension, type 2 diabetes and coronary artery disease.

Another indication of the economic costs of obesity is provided by health care resource utilization data. Obese Canadians also use a disproportionate amount of health care resources, including physician visits, admissions to hospital and use of medications (Trakas et al, 1999). They also report a greater number of disability days, which increase costs to employers and ultimately, to society at large (Trakas et al, 1999).

2.4.1.3 Prevalence

The most recent measured data on the prevalence of obesity in Canada were obtained during the National Heart Health Surveys, conducted between 1986 and 1992. A probability sample of almost 30,000 men and women aged 18 to 74 years was selected using health insurance registration files in each province and anthropometric measurements were performed on almost two-thirds of participants. Nationally, 35% of men and 27% of women were classified as obese (BMI > 27) and when a less stringent criterion was used (BMI > 25), 57% and 48% of men and women, respectively, were at potential health risk from overweight (MacDonald et al, 1997). Regional analysis of the data (eastern, central and western Canada) indicated that the prevalence of obesity was lower in western and central Canada than in the Atlantic provinces (Reeder et al, 1997).

Data from the B.C. Heart Health Survey, collected in 1989, revealed an overall prevalence of obesity (BMI>27) of 28%, considerably lower than the Canadian average (Ministry of Health, Province of British Columbia and Health and Welfare Canada, 1990). The prevalence of BMI>27 increased steadily with age in both men and women. In men, prevalence was 22%, 35% and 44% for those aged 18-34, 35-64 and 65-75, respectively. In women, corresponding values were 17%, 28% and 38%.

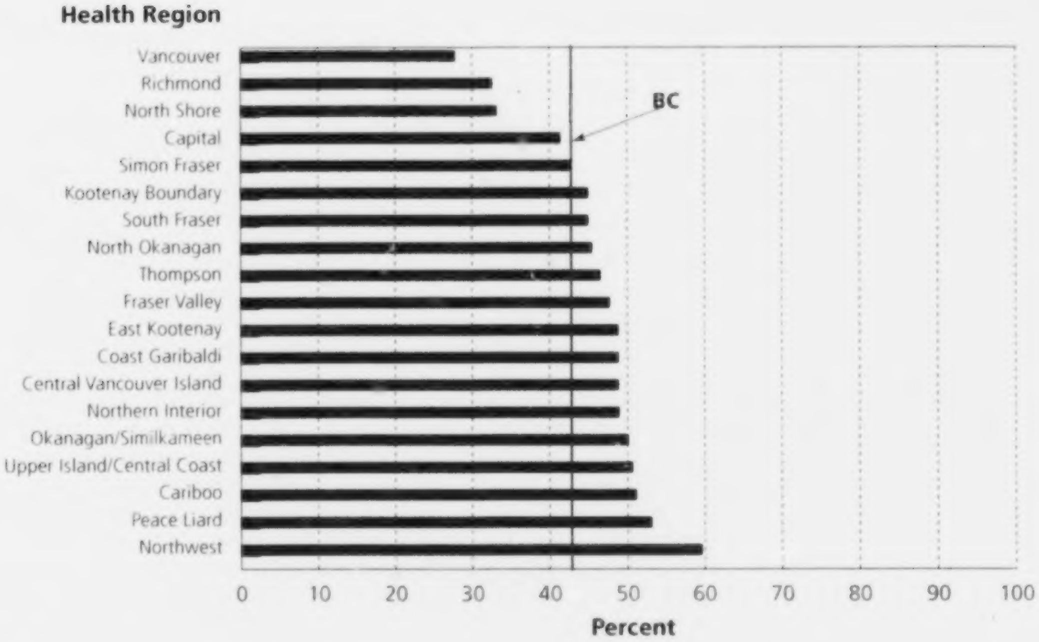
More recent B.C. data are available from the longitudinal National Population Health Survey (NPHS), conducted beginning in 1994-1995 and continuing every two years until 1998-1999 (Table 2.11). In 2000-2001, the Canadian Community Health Survey (CCHS) was introduced and provided cross-sectional data at the provincial and regional levels. Although the data were self-reported and thus likely underesti-

Table 2.11 Proportions of Canadian and B.C. adults aged 20-64 with self-reported BMI classified as underweight (<20), acceptable (20.0 – 24.9), some excess weight (BMI 25.0 – 27.0) or overweight (>27.0), 1994-5 through 2000-01

	NPHS 1994 - 1995		NPHS 1996 - 1997		NPHS 1998 - 1999		CCHS 2000 - 2001	
	Canada	**B.C.**	**Canada**	**B.C.**	**Canada**	**B.C.**	**Canada**	**B.C.**
Women and Men	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**
BMI <20	8.5	9.3	8.0	7.5	7.2	8.7	8.1	9.0
BMI 20.0 – 24.9	42.2	46.4	42.2	45.9	41.6	44.9	42.9	46.4
BMI 25-27.0	18.7	17.4	18.6	19.3	19.0	17.3	15.6	15.3
BMI >27.0	29.4	25.7	28.1	26.1	31.2	28.4	31.9	27.0
Missing	1.2	1.3	3.0	1.2	1.0	0.8	1.6	3.7
Women								
BMI <20	13.5	15.5	13.4	12.2	11.4	13.7	12.3	13.9
BMI 20.0 – 24.9	46.6	52.1	46.7	52.7	47.7	51.5	45.9	49.0
BMI 25-27.0	13.3	11.1	13.1	13.3	13.6	12.5	11.6	10.3
BMI >27.0	24.9	19.7	22.2	20.2	25.7	21.7	27.5	23.1
Missing	1.8	-	4.7	-	1.5	-	2.6	3.7
Men								
BMI <20	3.6	3.3	2.8	2.9	3.1	3.6	3.9	4.2
BMI 20.0 – 24.9	38.0	40.7	37.9	39.2	35.5	38.1	39.9	43.8
BMI 25-27.0	24.0	23.5	23.9	25.2	24.2	22.1	19.5	20.2
BMI >27.0	33.8	31.6	34.0	32.0	36.6	35.2	36.1	30.8
Missing	0.6 -	1.4 -	0.6	-	0.6	1.0		

Source: Statistics Canada, Health Indicators 2002. National Population Health Survey, 1994-5 through 1998-9, and Canadian Community Health Survey, 2000-01.

Figure 2.1 Regional comparisons of body mass index[1]



[1] Body Mass Index (BMI), Canadian Standard, Excess Weight (BMI ≥ 25.0),
Sexes Combined, Household Population Aged 20-64, by Health Region, B.C., 2000/01
Source: Canadian Community Health Survey cycle 1.1, 2000-01.

mate actual BMI, they confirm that the prevalence of obesity is lower in B.C. than in Canada as a whole and also indicate that women are less likely than men to report a BMI > 27 or between 25 and 27. Nevertheless, overweight and obesity still represent a concern for a substantial proportion of the B.C. population.

The 2000-2001 CCHS data allows regional comparisons to be made of the proportion of excess weight (BMI 25+) within the B.C. population (Figure 2.1). While provincially 42.3% of adults were classified with excess weight, regionally this varied from 27.8% in Vancouver to 59.6% in the Northwest (B.C. Ministry of Health Planning, September 2002).

There is every reason to expect that obesity will become even more prevalent in the years to come. First, national data indicate that since 1985, the proportion of adult Canadians that is overweight has increased substantially (Federal, Provincial and Territorial Advisory

Committee on Population Health, 1999). Second and perhaps of greater concern, is the large increase in childhood obesity that has been observed over the past 15 years. Tremblay and Willms (2000) recently analyzed nationally representative data from the 1981 Canada Fitness Survey, the 1988 Campbell's Survey on the Well-being of Canadians and the 1996 National Longitudinal Survey of Children and Youth. The 1981 data were used as a baseline to define "overweight" as a BMI equal to or above the 85th percentile and "obese" as a BMI equal to or above the 95th percentile. Accordingly, the prevalences of overweight and obesity in 1981 were 15% and 5% by definition. Between 1981 and 1996, the prevalence of overweight increased from 15% to 28.8% in boys and 23.6% in girls, while the prevalence of obesity more than doubled from 5% to 13.5% in boys and 11.8% in girls (Tremblay and Willms, 2000). Regional data were not reported.

2.4.2 Poor Body Image and Disordered Eating

2.4.2.1 Overview

It has been suggested that dissatisfaction with their own body has become almost normative among women living in Western cultures and may also be increasing among men. Among Canadians surveyed in the 1990 National Health Promotion Survey (Health and Welfare Canada, 1993), only 30% of women and 42% of men reported desiring no change in their current weight. Of those who desired a change, a large majority wanted to weigh less. Even when the responses of those at an acceptable weight were examined separately, 68% of women and 49% of men wanted to weigh less. And although obesity does represent a growing concern, in many cases weight loss may not be warranted. Yet 37% of women with body weight in the healthy range reported currently trying to lose weight in the 1990 Health Promotion Survey (Health and Welfare Canada, 1993). Furthermore, there may be a substantial proportion of individuals (particularly women) who, although not actively "dieting" to lose weight, are nevertheless extremely conscious of what and how much they are eating. This phenomenon (i.e., conscious efforts to control food intake in order to achieve or maintain a desired body weight) has been termed "cognitive dietary restraint" (Stunkard and Messick, 1985) and can be assessed using the restraint subscale of the Three-Factor Eating Questionnaire (Stunkard and Messick, 1985). Although one would anticipate that high levels of dietary restraint would be more common among individuals who are currently dieting for weight loss, many women who have body weights in the normal range and are not currently dieting also have high restraint scores (McLean, 1999).

2.4.2.2 Associated Health Risks

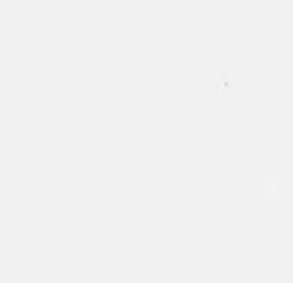
It could be speculated that some degree of dietary restraint is functional if it acts to prevent weight gain or to assist with weight loss in overweight individuals. However, high levels of restraint, particularly among those who do not need to lose weight for health reasons, may represent a health risk. Women with high scores for restraint and BMI within the healthy range have been found to have a higher incidence of subclinical ovulatory disturbances (Barr et al, 1994a; Barr et al, 1994b; Schweiger et al, 1992; Lebenstedt et al, 1999) and irregular menstrual cycles (McLean, 1999). Ovulatory disturbances, such as anovulation and cycles with a short luteal phase, are obviously related to reduced fertility in women. Furthermore, they were shown to be related to loss of spinal trabecular bone in young adult B.C. women (Prior et al, 1990) and to be associated with total body bone mineral content in women students at the University of British Columbia (McLean et al, 2001b). Little is known, however, about levels of dietary restraint in other age groups or in men.

2.4.3 Physical Inactivity

Physical inactivity is now recognized as an important risk factor for poor health outcomes, comparable to the effects of smoking, hyperlipidemia or hypertension (Physical activity and health, 1996; Pate et al, 1995). Because physical inactivity is more prevalent in Canada than are smoking, hypertension and hyperlipidemia (Katzmarzyk et al, 2000), this suggests that improvements in activity have the greatest potential to impact positively on health. Importantly, modest improvements in fitness have the greatest incremental benefits (Pate et al, 1995, Blair et al, 1995).

2.4.3.1 Confounding with Obesity

When considering the health impacts of inactivity, it is also important to note that considerable research has accumulated to indicate that physical inactivity may greatly confound the observed relationships between obesity and negative health outcomes (Blair and Brodney, 1999). For example, when physical fitness level was controlled, overall and cardiovascular disease mortality were considerably higher in 'unfit' men in the healthy weight range than in 'fit' men with BMI over 30 (Wei et al, 1999). Furthermore, only minimal differences were observed between obese and lean men of comparable fitness levels. The observed associations with obesity are thus largely due to the fact that physical inactivity and poor fitness are much more common among obese individuals than among those in the healthy weight range. For



example, among normal weight men, 9.3% were classified in the lowest quintile for fitness, while among overweight and obese men, 19.4% and 50.8% were similarly classified (Wei et al, 1999). Finally, improving physical fitness in overweight individuals can improve glucose tolerance, blood pressure and blood lipid levels, irrespective of meaningful changes in body weight or body composition (Wilmore et al, 1999, Leon et al, 2000, Rankinen et al, 1997). Given the difficulty of treating obesity once it is established, interventions to increase physical activity and improve physical fitness clearly have potential to impact meaningfully on population health.

2.4.3.2 Costs to the Health Care System

The costs of physical inactivity in Canada have recently been estimated (Katzmarzyk et al, 2000). Using an approach similar to that described above for obesity, the population attributable fraction was computed for coronary artery disease, stroke, colon cancer, type 2 diabetes and osteoporosis using relative risks associated with inactivity and the population prevalence of inactivity. The costs of inactivity were estimated at about $2.1 billion, at least as great as the costs of obesity.

2.4.3.3 Prevalence

Interpretation of data on the prevalence of physical inactivity is complicated by the use of different definitions across different surveys, making secular comparisons difficult. For example, the National Population Health Survey (Federal, Provincial and Territorial Advisory Committee on Population Health, 1999) estimated energy expenditure during leisure time physical activity and used values of >3.0 kcal/kg/d to represent "active", 1.5-2.9 kcal/kg/d to represent "moderately active" and <1.5 kcal/kg/d to represent "inactive". (To provide context, a 70 kg adult walking 2 miles/d at a moderate pace would expend about 170 kcal or about 2.4 kcal/kg and would thus be classified as moderately active.) Using this definition, 21% of Canadians were active, 23% were moderately active and 57% were inactive. Other surveys, using slightly different definitions, found that 62% of Canadians were not active enough to obtain the benefits of an active lifestyle (Craig et al, 1999) or that 66% were not meeting the activity guidelines specified in *Canada's Physical Activity Guide to Healthy Active Living* (Canadian Fitness and Lifestyle Research Institute, 1998). The Guide specifies an hour of low-intensity activity every day or 4-7 days per week of moderate-intensity activity (30-60 minutes per occasion) or high-intensity activity (20-30 minutes per occasion) (Health Canada and the Canadian Society for Exercise Physiology, 1998). Regardless of the definition used, however, it is apparent that the majority of Canadians are physically inactive.

The situation in British Columbia is somewhat better than that in other Canadian provinces, but is still far from optimal. Using the classification system of the National Population Health Survey (leisure time energy expenditure per kg/d leading to classifications of "physically active", "moderately active" and "inactive"), in 1996-1997 B.C. had the lowest prevalence of inactivity (50%) and the highest prevalence of active adults (27%) among Canadian provinces (Federal, Provincial and Territorial Advisory Committee on Population Health, 1999). However, the prevalence of inactivity had increased slightly from 1994-95, when it was 48% (British Columbia Ministry of Health, 1999). Data from the Canadian Community Health Survey, conducted in 2000/2001, indicate that British Columbians remain more likely to be physically active than Canadians as a whole (26.9% vs 21.0%) and less likely to be physically inactive (38.0% vs 49.1%) (Statistics Canada, 2002).

The Canadian Community Health Survey also provided information on physical activity by age (Statistics Canada, 2002). Among all Canadians, the proportion who were physically active decreased progressively with age, from 22.5% among those aged 19-34 to 15.2% among those aged 65 above, while the proportions classified as inactive increased from 47.2% to 56.1%. The proportion of physically active British Columbians also decreased progressively with age, from 29.6% in 19-34 year olds to 20.9% in those aged 65 and above. However, in B.C. the prevalence of physical inactivity did not increase progressively with age: although it increased between aged 19-34 and 35-44 from 36% to 41.3%, it remained relatively stable at 41%-42% among adults aged 45 and above.

2.4.4 Food Insecurity

2.4.4.1 Definitions

Food security is defined as "a condition in which all people at all times can acquire safe, nutritionally adequate and personally acceptable foods that are accessible in a manner that maintains human dignity. These are conditions that promote health by providing essential nutrients and minimizing food-related stress." (Canadian Dietetic Association, 1991) Conversely, food insecurity is defined as "the limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways" (Anderson, 1990). Recently, a standardized scale has been developed to assess the severity and prevalence of food insecurity (Carlson et al, 1999). This instrument contains 18 questions that assess the spectrum of food insecurity, ranging from concern that food would run out, to skipping meals because of inadequate food, to not eating for

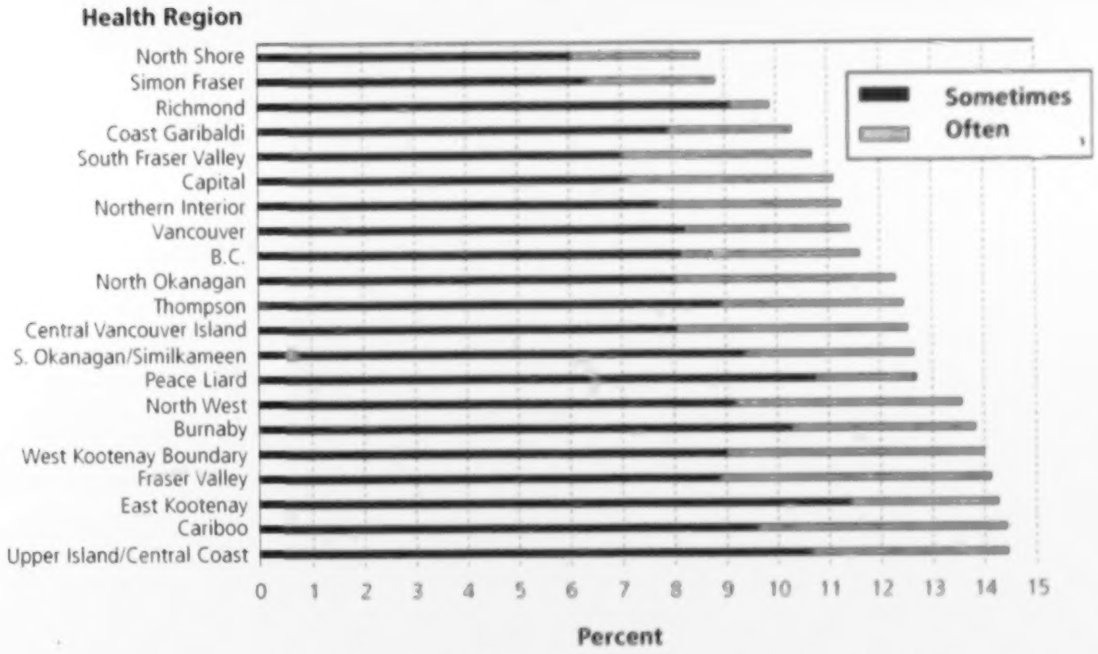
a whole day. Although national Canadian data are not available using this instrument, U.S. data showed that in the 12 months preceding April 1995, almost 12% of U.S. households experienced food insecurity, including 4.1% with a recurring pattern of hunger (Carlson et al, 1999).

Canadian data on food insecurity were obtained in the 1998/99 National Population Health Survey (NPHS) (Che and Chen, 2001). Individuals were considered to be living in a food insecure household if they answered "yes" to any of the following questions: "In the past 12 months, did you or anyone in your household: 1) Worry that there would not be enough to eat because of a lack of money? 2) Not eat the quality or variety of foods that you wanted because of a lack of money? 3) Not have enough food to eat because of a lack of money?" Those who answered "yes" only to the first question were considered to be "worried", while those responding in the affirmative to the second or third questions were defined as having a "compromised diet". Overall, over 10% of Canadians were defined as living in food insecure households, with 8% experiencing a compromised diet (Che and Chen, 2001).

The 2000-01 Canadian Community Health Survey repeated the questions from the NPHS and found that for British Columbians: 11.63% reported sometimes or often worrying that there would not be enough to eat; 14.83% reported sometimes or often not eating the quality of foods wanted; 8.16% reported sometimes or often not having enough to eat (unpublished data, B.C. Ministry of Health Services, January 2003). Figures 2.2a-c show the regional differences in food insecurity reported.

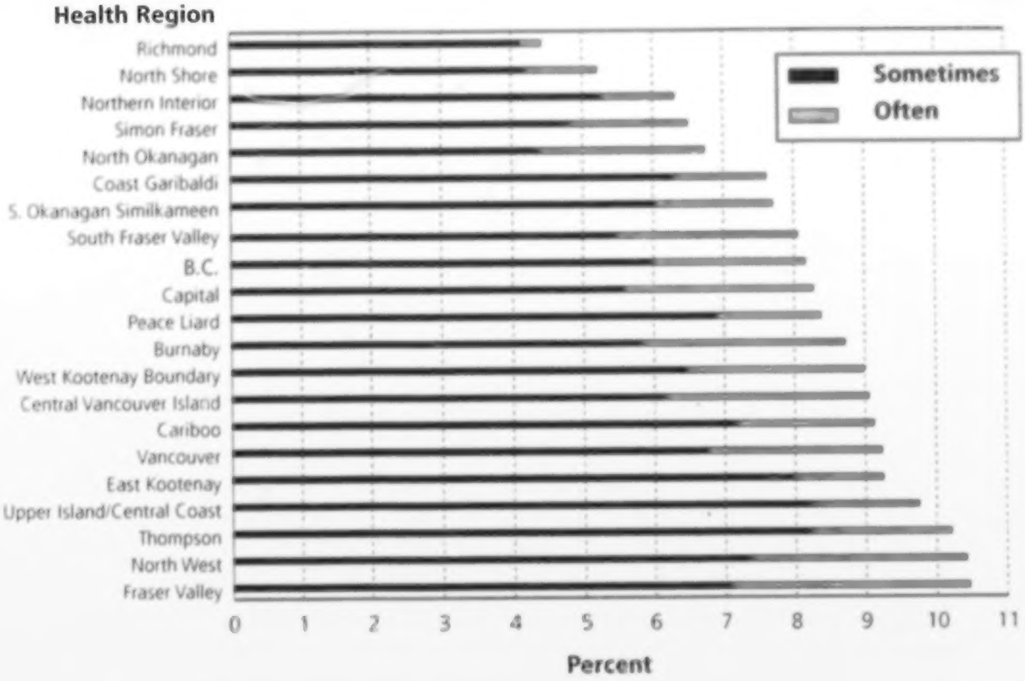
Figure 2.2a Regional comparisons in food insecurity.

1. In the past 12 months, how often did you or anyone else in your household worry that there would not be enough to eat because of a lack of money?



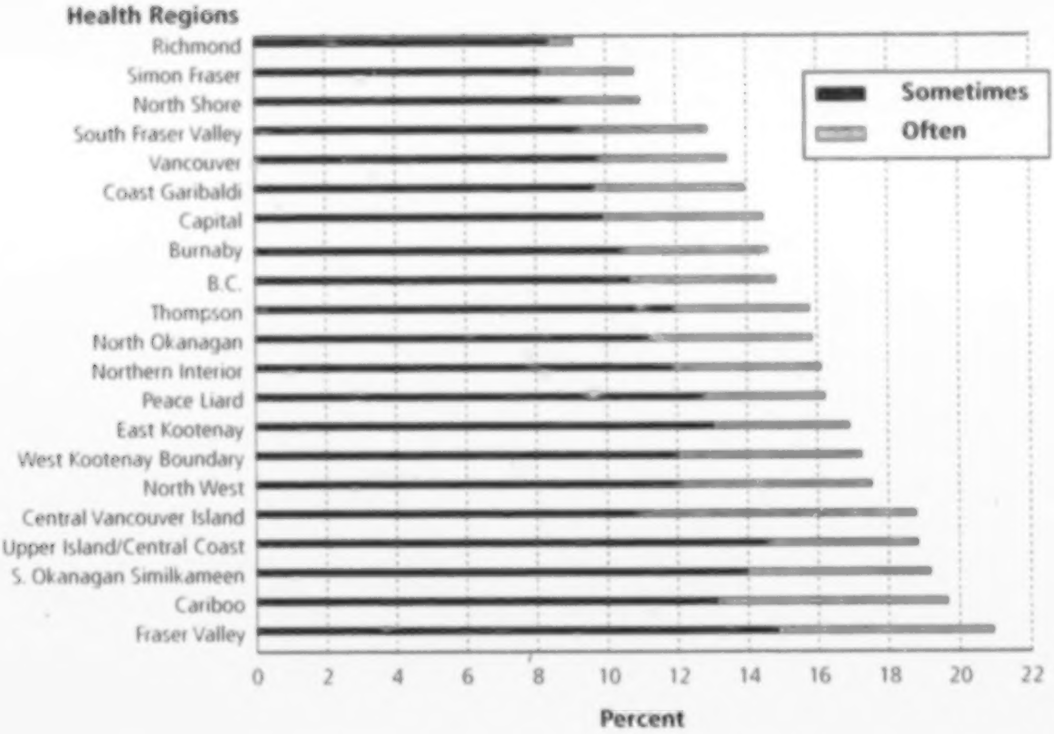
Source: Canadian Community Health Survey: Cycle 1.1, 2000/2001

Figure 2.2b: Regional comparisons in food insecurity
In the past 12 months, how often did you or anyone else in your household not have enough food to eat because of a lack of money?



Source: Canadian Community Health Survey: Cycle 1.1, 2000/2001

Figure 2.2c Regional comparisons in food insecurity
In the past 12 months, how often did you or anyone else in your household not eat the quality or variety of foods that you wanted to because of a lack of money



Source: Canadian Community Health Survey: Cycle 1.1, 2000/2001

2.4.4.2 Associated Health Risks

It is well-known that poverty is associated with poor health outcomes: For example, the incidence of heart disease and all other chronic diseases studied, was significantly higher for those in the lowest 40% of income adequacy than for those in the upper 60% (Statistics Canada, 1998). B.C. data also show close links between the average socio-economic status (SES) of health regions and health outcomes. Using a combined index of SES that incorporated education (percent of those age 25-54 who did not complete high school), employment (unemployment rate among those aged 15 and above) and income (percent of the population aged up to 64 on income assistance), a linear relationship was observed with premature deaths, expressed as potential years of life lost (years before age 75) per 1000 population (British Columbia Ministry of Health, 1999a).

Food insecurity and income are not completely synonymous, however and the nutritional and broader social consequences of food insecurity are only beginning to be examined and understood (Hamelin et al, 1999). Food insecurity was shown to be related to nutrient inadequacy in a sample of 153 low-income women in Toronto Ontario (Tarasuk and Beaton, 1999) and large surveys in the U.S. have also documented this relationship (Rose, 1999). Other health outcomes may also be affected by food security. For example, in the United States, the least severe level of food insecurity (described as household food insecurity) was found to be associated with a higher BMI and increased prevalence of obesity in women, even when other available and known correlates of obesity (including income level) were controlled (Olson, 1999). In low income school-age children, the risk of hunger and hunger itself were associated with lower scores on an instrument designed to assess psychosocial functioning, even when socio-economic status was controlled (Olson, 1999). Canadian data from the NPHS found that, compared to food secure households, food insecure households were significantly more likely to describe their health as poor or fair (17% vs 7%); to have three or more chronic conditions (21% vs 14%); to be obese (15% vs 12%); to experience distress (31% vs 10%); and to be at risk for depression (14% vs 4%) (Che and Chen, 2001).

2.4.4.3 Relative Food Costs in British Columbia

Although the above examples suggest that food insecurity has consequences that may be independent of income level, income is one factor that has an obvious impact on the ability to achieve food security (Rose, 1999), through its influence on the ability to purchase sufficient quantities of nutritious food. B.C. data on food costs and expenditures are available from Family Food Expenditure in Canada and recent surveys conducted by B.C. community nutritionists.

2.4.4.3.1 Family Food Expenditure in Canada

The Family Food Expenditure in Canada survey, conducted in 17 Canadian cities in 1984, showed clearly that as income increased the amount spent per person on food each week increased, averaging about 35% higher in the highest compared to the lowest quintile (Statistics Canada, Household Surveys Division, 1986). However, there were relatively few differences in per capita expenditure for various food commodities by income level (i.e., the amounts spent per person per week on meat, fruit, vegetables, etc did not vary substantially by income quintile). Where differences were seen was in the amounts spent on food purchased from restaurants and this rose with income level. Only two B.C. cities were surveyed (Victoria and Vancouver) and at that time, food prices appeared similar to or slightly lower than the average of the 17 cities surveyed. Thus, in 1984 it appeared that relative income did not have a major impact on British Columbians' ability to purchase basic food commodities.

2.4.4.3.2 The Cost of Eating in B.C.

Since 1984, however, the gap in income between the lowest quintile and the highest quintile has likely broadened considerably and it cannot be concluded that relative income does not impact on the ability to purchase adequate amounts of nutritious foods. For example, beginning in June 2000, B.C. community nutritionists surveyed 130 grocery stores in 16 provincial health regions to determine the cost of healthy eating (Dietitians of Canada and Community Nutritionists Council of B.C., 2002). Health Canada's National Nutritious Food Basket 1998, consisting of 66 foods chosen to reflect basic energy and nutrient needs, was used for the survey. Results of the 2000 survey and subsequent surveys show that many families living on social assistance or with a single parent working for minimum wage would be at risk for food insecurity.

2.5 Senior Citizens

2.5.1 Population Trends in Canada and B.C.

The proportion of the population that is 65 years and above has been increasing in Canada for a number of years and it is apparent that this trend will continue for at least the next 25 years. For example, it was estimated that as of July 1, 2000, 12.5% of Canadians were aged 65 and over. Projections for the years 2011, 2016 and 2026 suggest that these proportions will rise to 14.5%, 16.5% and 21.4% respectively (Statistics Canada, website accessed December 2000). In July 2000, the age distribution of the B.C. population did not differ greatly from the Canadian average, with about 13% of British Columbians aged 65 and over (Government of British Columbia, Ministry of Finance and Corporate Relations, website accessed December 2000). This population sector is projected to undergo the largest increase of any age group in the province over the next 25 years, increasing to 20.8% by the year 2025. At that time, there will be more B.C. seniors than children and adolescents combined.

2.5.2 Health and Nutritional Status

Although most older adults in North America do not suffer from overt nutrient deficiencies, surveys reveal a prevalence of marginal nutrient intakes (U.S. Department of Agriculture, Food Surveys Research Group, website accessed December 2000), an increased risk of malnutrition and subclinical deficiencies that may affect function and quality of life (Blumberg, 1997; Lesourd et al, 1998; Vailas et al, 1998; Weddle et al, 1996). Lower energy requirements with aging, associated with loss of lean body mass and less physical activity, contribute to these nutrition problems (Gariballa and Sinclair, 1998). Thus, from the nutrition perspective, older adults represent a group at potential risk.

2.5.2.1 Cardiovascular Risk Factors

As in all Canadians, cardiovascular disease is the leading cause of death in those aged 65 and above (Heart and Stroke Foundation of Canada, 1997). National data on the prevalence of risk factors in seniors 65 and above from the Heart Health Surveys has been published (Langille et al, 1999). The five risk factors assessed included smoking, hypertension, elevated blood lipids, physical inactivity and BMI; results indicated that all but 4% of senior Canadians had at least one major risk factor and 50% had three to five. Comparable data are available for senior British Columbians and these values are compared to the national data in Table 2.12. Although it appears that the prevalence of hypertension

is considerably lower in B.C. than in the rest of Canada, the definitions used were not identical: Nationally, hypertension was defined as one or more of systolic blood pressure >140 mm Hg, diastolic blood pressure > 90 mm Hg, on prescription medication for hypertension or on dietary therapy for hypertension (Langille et al. 1999), while in B.C., only the latter three criteria were included. With regard to other risk factors, it appears that the prevalence of hypercholesterolemia and a high BMI are similar in B.C. and Canada, while the prevalence of smoking is somewhat lower in B.C. Inactivity appears to be considerably less prevalent in B.C; however, it should be noted that the criterion used for "being active" was exercising at least once a week for at least 15 minutes. This clearly would not provide the amount of activity required for health benefits.

2.6 Summary

In summary, the last comprehensive nutrition survey of British Columbians was the Nutrition Canada National Survey of 1970-1972. At that time, few differences were observed between average intakes of British Columbians and Canadians as a whole. The data suggested that median intakes of most nutrients were adequate in most age groups, but that considerable proportions of women and seniors had inadequate or less-than-adequate intakes of several nutrients. Since then, comprehensive provincial or national intake data have not been collected, with the exception of a survey of about 1500 Canadian adults in 1997-1998. That study indicated that, since the time of the Nutrition Canada survey, decreases had occurred in fat intake as a percentage of energy, while intakes of most vitamins and minerals had increased. Food disappearance data collected over the same time period appear to support these observations.

Table 2.12 Prevalence of cardiovascular risk factors in men and women aged 65-74, Canada and British Columbia

Risk Factor	Men		Women	
	Canada	B.C.	Canada	B.C.
Hypertension[1]	56	28	58	30
Cholesterol ≥ 6.2 mmol/L	23	23	40	42
Smoking	19	13	16	12
Exercise < 1/wk	43	19	49	33
BMI > 27	40	44	40	38

[1] Different definitions of hypertension were used to develop the Canadian (Langille et al. 1999) and B.C. data (Ministry of Health, Province of British Columbia and Health and Welfare Canada, 1990).

In addition to information on nutrient intakes, data are also available on nutrition-related knowledge, attitudes and behaviours. The 1989 B.C. Heart Health Survey provided information about British Columbians' knowledge and awareness with regard to cardiovascular disease risk. Although cardiovascular disease mortality has decreased since the 1960s and B.C. has the lowest age-standardized rate, it remains the leading cause of death in both Canada and B.C. The survey concluded that there was a need for public education programs to provide practical guidance on reducing total and saturated fat intake. In support of this, Tracking Nutrition Trends, a 1997 survey commissioned by the National Institute of Nutrition, found that fat intake was the primary food/nutrition concern among Canadians. Most of those concerned about fat reported having changed their diets; however, the proportions planning to make additional changes decreased between 1994 and 1997. Dietary intake data are needed to determine whether this reflects that additional changes are not required or whether consumers are becoming less sensitive to this issue. Finally, the survey also reported that a majority of Canadians were aware of *Canada's Food Guide to Healthy Eating* and could name the four major food groups, but that British Columbians had lower levels of knowledge and awareness than the national sample.

Obesity is recognized as a major risk factor for a number of chronic conditions and contributes significantly to health care costs. The prevalence of obesity is lower among British Columbians than among Canadians as a whole, but over one in two B.C. adult men and about one in three B.C. women have a BMI that places them at risk from overweight. The prevalence of obesity appears to be increasing and there is reason to believe that this trend will continue.

At the same time as obesity appears to be increasing in prevalence, the prevalence of dieting and concern about body weight are high, even among those who are not in a BMI category that reflects health risk. High levels of cognitive dietary restraint (the attempt to limit food intake in an effort to achieve or maintain a desired weight), appear to be common in normal-weight young urban B.C. women and are of potential concern with regard to fertility and bone health. Little is known about the levels of restraint among other age/sex groups.

Like obesity, physical inactivity is also recognized as a risk factor for poor health outcome and has been shown to contribute to health care costs. The prevalence of physical inactivity increases substantially as relative body weight increases and considerable research suggests that much of the health risk associated with overweight may instead result from physical inactivity. British Columbians are less likely to be physi-

cally inactive than are Canadians as a group; however, at least half of B.C. adults do not engage in the amounts of physical activity recommended for health.

Food insecurity and its potential impact on nutritional health have only recently been recognized as concerns in North America. Although related strongly to income, food insecurity has been demonstrated to have an independent influence on risk of obesity in adult women and on psychosocial functioning in low income school-age children. Nationally representative Canadian data on the prevalence of food insecurity are not available, but data from the Canadian Community Health Survey and recent surveys on food costs in B.C. communities suggested that some low income British Columbians may not be able to afford to eat well.

3.0 Methodology

3.1 Introduction

This chapter describes the methodology used for the BCNS including sampling strategies, survey instruments, survey staff recruitment and training and data entry and analysis. The chapter begins with a discussion of the BCNS in relation to other provincial nutrition surveys.

3.2 Background

The BCNS is a collaborative effort between the British Columbia Ministry of Health Services (Ministry), Health Canada and the University of British Columbia (UBC). The Ministry managed the data collection phase, Health Canada was responsible for the data entry and analysis phases and UBC led the data interpretation phase. The ethical approval for the BCNS was obtained from UBC's Office for Research Services and Administration Behavioural Research Ethics Board.

The BCNS benefited greatly at all phases of the study from experience of the nine other provinces that completed nutrition surveys prior to B.C. The expert advice from Health Canada and Statistics Canada was also invaluable to the success of the study.

For comparative purposes, the BCNS used as much as possible the protocols from Health Canada and Statistics Canada for sampling, staff training, data collection, entry and analysis. The protocols were developed for the Nova Scotia Nutrition Survey conducted in 1988 and were followed by subsequent provincial surveys (Nova Scotia Department of Health, 1993; Sante Quebec, 1995; Stephen and Reeder, 2001; Taylor et al, 2002). There were four components common to all the provincial surveys – 24-hour dietary recall, food frequency questionnaire, demographic questionnaire and anthropometric measurements – plus a fifth general nutrition and health questionnaire component with content relevant and specific to each province.

Because the content of the general questionnaires varied greatly among the provinces and reflected the changing nutrition priorities over the eleven years between the first and last provincial nutrition survey, there is little or no opportunity for inter-provincial comparisons. Furthermore, because the dietary recalls for the latter three surveys (Ontario, Manitoba and British Columbia) were analysed using the 1999 version of the Canada Nutrient File, comparisons of nutrient intakes would be possible only among these three provinces.

3.3 Sample

3.3.1 Target Population

The target population for the BCNS was adults aged 19 to 84 years, who were residing in the province at the time of the BCNS. Persons living in care or correctional facilities were excluded from the sample because their diets would be influenced by their institutional situation. Individuals living on military bases or Indian reserves were excluded from the sample because responsibility for surveys of these populations is not part of the mandate of Health Canada. Pregnant and lactating women, although included in the sample, were not eligible to participate in the BCNS due to their special nutritional requirements.

The target population was extended beyond the 19 to 74 years required by Health Canada to include individuals aged 75 to 84 years. Older seniors were a particular focus for the BCNS because they may be at greater nutritional risk than younger seniors due to potentially higher prevalences of food insecurity, chronic diseases and other debilitating conditions and social isolation.

3.3.2 Sampling Frame

The sampling frame used for the BCNS was the B.C. Health Registry, a central repository of standard identifying information related to persons who are eligible to receive Ministry of Health Services programs including Medical Services Plan, Pharmacare and hospitals. Each individual who obtains health services in B.C. is assigned an unique numeric identifier – a personal health number (PHN). Each PHN contains identification information (name, date of birth and gender) and locator information (address and phone number). A memorandum of understanding regarding access to the client registry data and confidentiality of the personal information was established between the B.C. Health Registry and the Investigative Team.

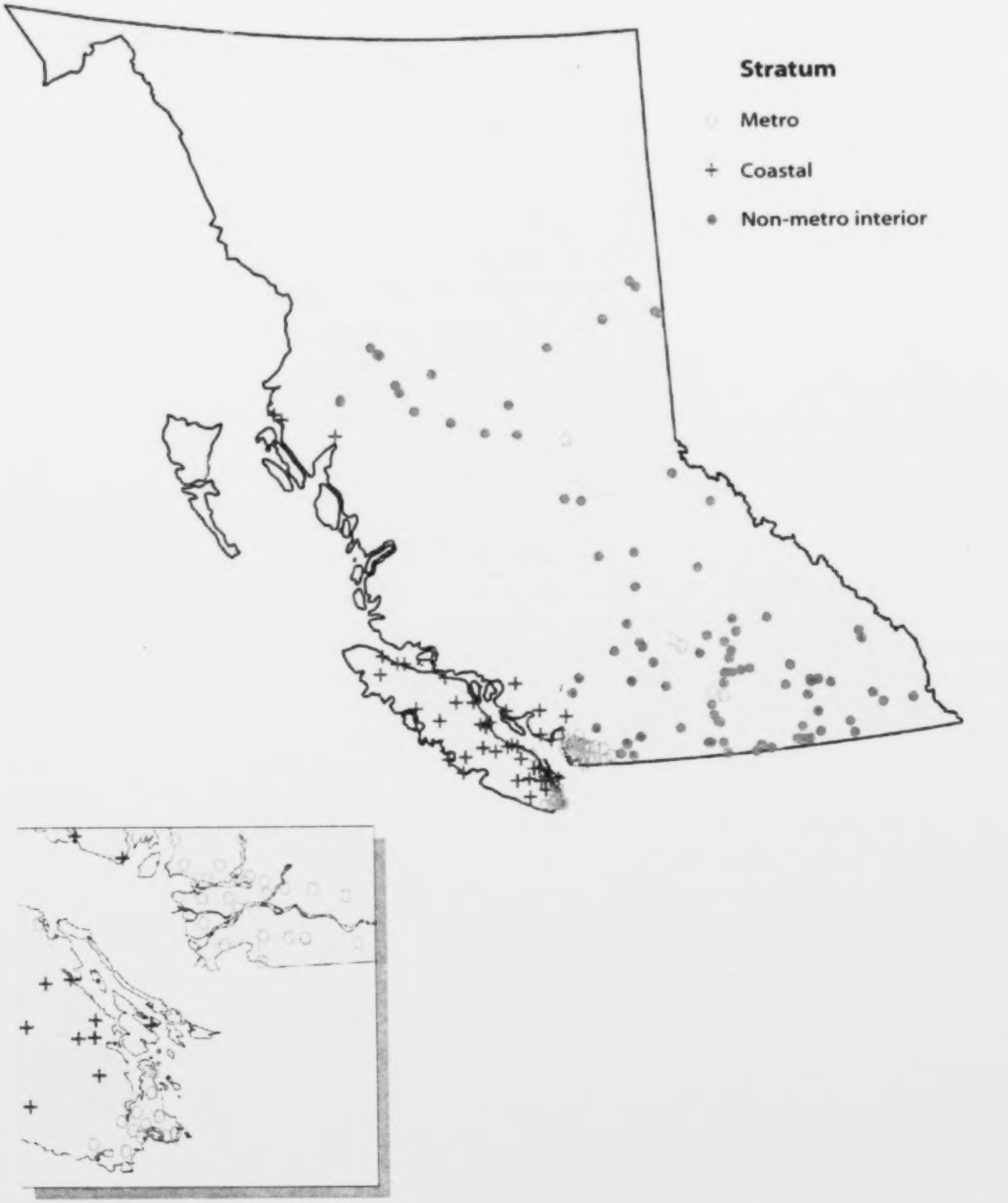
3.3.3 Geographic Stratification

The 1996 Census Sub-Divisions (CSDs) were used to define three geographic strata. (See Figure 3.1.) First, the out-of-scope CSDs, to be excluded from the data collection due to remoteness, were determined with the assistance of BC Stats demographers using criteria such as more than a three-hour drive from health unit office; inaccessible by car alone; scarce population density. Then, the remaining in-scope CSDs were divided into three geographic strata:

1. Metro (6 Census Metropolitan Areas – Vancouver, Victoria, Nanaimo, Kamloops, Kelowna, Prince George);
2. Coastal – rural island and coastal communities; and
3. Non-metro Interior – other rural communities.

The decision to divide the province into three strata, instead of the traditional two strata (urban and rural), was based on the expectation that rural coastal populations would differ from rural interior populations in health behaviours influenced by socio-demographic factors. The sample was designed to allow comparisons among these three strata.

Figure 3.1 Geographic strata for the B.C. Nutrition Survey


Stratum
○ Metro
+ Coastal
● Non-metro interior

Prepared by: BC Stats, Victoria

The Non-metro Interior stratum was further divided into ten clusters that closely approximated health authority boundaries. With staffing and travel costs in mind, the sampling frame for this stratum included four of these ten clusters.

In 1999, there were twenty health authorities designated in B.C. The sample included individuals from all but three health authorities – Peace/Liard, Cariboo and East Kootenay were excluded from the study. The sample was not designed to allow comparisons to be made among the health authorities. A sample sufficiently large to obtain regionally valid information in B.C. would be cost-prohibitive.

3.3.4 Sample Design

Details of the sample design specifications, developed by Statistics Canada, are provided in Appendix A. It was a two-stage probability sample design.

In the first stage, all individuals in stratum 1 and stratum 2 and all individuals in four of the ten clusters in stratum 3 were chosen as in-scope CSDs.

In the second stage, all individuals in the B.C. Health Registry from in-scope CSDs who were aged 18 to 84 years at the time of the data collection in the selected strata and clusters were chosen. They were stratified into 14 age-sex groups:

18-24 years old males	18-24 years old females
25-34 years old males	25-34 years old females
35-44 years old males	35-44 years old females
45-54 years old males	45-54 years old females
55-64 years old males	55-64 years old females
65-74 years old males	65-74 years old females
75-84 years old males	75-84 years old females

3.3.5 Sample Size

An expected sample size of 2200 individuals aged 18 to 74 years and 500 individuals aged 75 to 84 years was determined by Statistics Canada. The expected sample size was corrected for out-datedness of the sampling frame, which was estimated to be 20% for all age/gender groups by the B.C. Health Registry. The expected sample size was also adjusted to deal with anticipated non-response upon the advice of BC Stats demographers. The non-response factors varied by characteristics of the age/gender groups, such as the transience of young adults and the frailty of older seniors. The allocation was performed proportionally to (population

size)$^{1/3}$ to give less importance to the largest stratum and more to the smaller ones. A file of 5320 names was drawn from the B.C. Health Registry – 2660 for the spring season and 2660 for the fall season.

3.3.6 Selection Procedure

With the assistance of the Ministry economist, a multi-step selection procedure, determined by Statistics Canada, was used to assign the following:

- an identification number;
- Fall versus Spring data collection;
- day of the week for first 24-hour recall for every person; and
- day of the week for the second 24-hour recall for every third person.

With the assistance of the Ministry epidemiology research officer, participant lists for the spring and fall seasons were created based on postal codes of the names drawn.

3.4 Survey Components

According to Health Canada protocols and similar to other provincial surveys, the BCNS had five components – the 24-hour Recall, the Food Frequency Questionnaire, the Nutrition, Activity and Health Questionnaire (Provincial Questionnaire), the Demographic Questionnaire and anthropometric measurements. Copies of the survey instruments are included in Appendices B-E.

3.4.1 24-hour Dietary Recall

In the BCNS, dietary intake was assessed in a personal interview by the 24-hour dietary recall method, an open-ended technique in which the respondent is asked to recall all foods, including beverages, consumed in the previous 24 hours. Details that affect nutrient composition are recorded, such as added condiments, spreads and salt and cooking methods. Whenever possible, recipe ingredients, product brand names and grocery store or restaurant sources are included as well.

The accuracy of the 24-hour recall methods depends on the memory and honesty of the respondents. Because of embarrassment or desire to please or impress, respondents tend to over-report consumption of foods perceived to be healthy and under-report consumption of foods perceived to be unhealthy (Lee and Nieman, 2003). Overall, there is a tendency to under-report energy intake, which appears to be more pronounced in overweight individuals (Briefel et al, 1997).

In an attempt to obtain accurate intake data, the BCNS used a standardized "multi-pass" system of questioning with unbiased, supportive and non-judgmental probes. This involved the interviewer and respondent reviewing the recall three times in order to obtain successively more detailed and complete information. Portion sizes were estimated using a 70-item kit with three-dimensional food models and household measures in order to improve recall accuracy.

However, no matter how accurate the recall information, a single day's food intake is a very poor descriptor of an individual's usual food intake due to day-to-day or intra-individual variability. Therefore, in order to assess intra-individual variability in food intake, repeat recalls were conducted on one-third of the sample. These took place at least one week following and on a different day of the week than the first recall.

While one 24-hour recall is almost never representative of an individual's usual intake, sufficiently large numbers of 24-hour recalls, adjusted for within-person variability, can provide a reasonable estimate of the intake of populations. Therefore, the 24-hour dietary recall was an appropriate method for the BCNS. Some other advantages of this method for population surveys are that it is easily and quickly administered; it has a low respondent burden; and it is relatively inexpensive (Lee and Nieman, 2003).

Information on the type, amount and frequency (i.e., yesterday, monthly) of nutritional and non-nutritional supplements was also collected as part of the 24-hour dietary recall (Appendix B). Whenever possible, information, including the brand name and DIN (drug information number), was recorded directly from the labels. For the BCNS, the definition of non-nutritional supplements included everything that was not vitamin and/or mineral, including herbal, botanical and homeopathic preparations.

3.4.2 Food Frequency Questionnaire

In the BCNS, a semi-quantitative food frequency questionnaire was used to obtain detailed information on the usual consumption of various foods of interest primarily to Health Canada. The Food Frequency Questionnaire was not a comprehensive tool. Rather, it was developed for the Nova Scotia Nutrition Survey with a focus on fat intake and evolved over time to deal with some foods that are eaten less often or seasonally (for example, broccoli) and some foods that are toxicologically important (for example, liver).

Participants were asked about their frequency of consumption during a specific time period (past day/week/month) and their average portion size of 41 food items that were common to all provincial nutrition surveys. The B.C. survey added five food items at the request of the B.C. Ministry of Agriculture, Food and Fisheries. Information on these five food items – bell peppers, tomatoes, tomato juice, cranberries and cranberry juice – will support provincial marketing and production decisions.

The Food Frequency Questionnaire also included questions required by Health Canada about consumption of added fat and reasons for choosing foods. It also contained questions added by the Ministry to identify respondents who were vegetarians, who were following a special diet or who were diagnosed with a nutrition-related chronic disease.

Health Canada and the Ministry of Agriculture, Food and Fisheries will use the results of the Food Frequency Questionnaire for internal research and evaluation projects. Because the Food Frequency Questionnaire data do not add to the information on nutrient intakes already provided by the 24-hour dietary recall data, the findings from the Food Frequency Questionnaire will not be reported in this document.

3.4.3 Nutrition, Activity and Health Questionnaire (Provincial Questionnaire)

The Provincial Questionnaire was unique to B.C. Its content was chosen to address provincial nutrition priorities in food security, physical activity, healthy weight and body image. The Provincial Questionnaire also included questions on food safety, dental health and wild food use in the Spring season to support complementary public health initiatives.

The content of the questionnaire was determined after consultation with stakeholders including government and non-government agencies. To the extent possible, the questions selected met these five criteria:

- The information was not available through another source.
- The information could best be collected through face-to-face interviews.
- Program policy decisions depended on the information.
- There were a large number of users of the information.
- Valid/reliable questions were available.

The questions were tested on twenty consumers who spanned the same age range as the target population and revised and re-tested by researchers at UBC to ensure that the questions were as clear and specific as possible. In addition, questions that were not part of standardized questionnaires were revised based on recommendations of a plain language review. The time required to complete the provincial questionnaire was checked to make certain it met the 30-minute guideline.

3.4.3.1 Physical Activity

The physical activity questions focused on physical activity levels in work and leisure time, motivational readiness to adopt exercise and physical activity and the barriers to adopting an active lifestyle. The Godin Leisure Time Exercise Questionnaire was used to assess leisure-time physical activity (Godin and Shephard, 1985). For the purposes of assessing motivational readiness for physical activity, two different definitions of physical activity were used: one used a definition that reflects structured exercise and the other used a broader lifestyle activity (unstructured exercise) definition. Motivational readiness for each of these two types of exercise was assessed using a staging algorithm based on the Transtheoretical Model of Behaviour Changes (Marcus and Simkin, 1994). Additional details on the methodology and results pertaining to physical activity are presented in the *Report on Physical Activity and Body Weight.*

3.4.3.2 Healthy Weight and Body Image

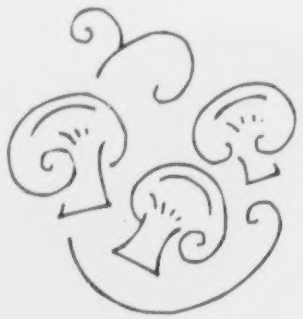
The healthy weight and body image questions focussed on perceived weight status, weight change efforts, body image and eating behaviour (Stunkard and Messick, 1985; Health and Welfare Canada, 1990). In addition, a question about bodily comfort was developed.

3.4.3.3 Food Security

Food security means that all people at all times have dignified access to sufficient food that is safe, nutritious and culturally appropriate and has been produced in a manner that is environmentally and socially sustainable. Hunger is the inability to obtain and consume sufficient food that is safe, nutritious and culturally appropriate because of lack of money.

Three screening questions from Statistics Canada National Health Population Survey were used to identify participants who experience food insecurity (Che and Chen, 2001). Three additional questions from the Human Resources Development Canada Food Insecurity Supplement were used to determine prevalence and severity of food insecurity among identified participants (Che and Chen, 2001).

The four remaining questions, asked of all participants, dealt with food action programs (for example, community kitchens) and food shopping practices (for example, choosing organic food) and were developed to support provincial policy and program development related to food security.



3.4.3.4 Dental Health, Food Safety and Wild Food Use

There were six questions about personal oral health and dental health practices taken from a Scottish dental practices survey (Kelly et al, 2000) on the provincial questionnaire. There were four questions about food safety developed to determine food-handling practices in the home. The questions dealt with cooking food adequately, cooling cooked food rapidly and preventing cross contamination by washing hands and sanitizing dishcloths to prevent food borne illnesses, a major public health concern.

There were six questions about the consumption of locally caught and gathered foods (for example, wild mushrooms) designed to provide information on the prevalence, frequency and amount of consumption in the general B.C. population in order to interpret data on environmental contaminants in food.

These data (on dental health, food safety practices and wild food use) are not included in the present report.

3.4.4 Demographic Questionnaire

According to Health Canada protocols, date of birth and gender were confirmed and marital status, family composition, education and income were collected to characterize the sample, as well as to allow for comparisons in nutrient intake and food consumption among various demographic groups. Information on cigarette use was collected, including lifetime smoking behaviour, which is considered a better measure of exposure than present smoking practice (Heart and Stroke Foundation of Canada, 1997).

A question on aboriginal status was included to document the proportion of First Nations people included in the BCNS, which was expected to be small due to the exclusion of Indian reserves from the sample. The information will help build the case for a future survey targeting this important population.

3.4.5 Anthropometric Measurements

Measurements were taken according to protocols established by Health Canada and with the awareness of potential personal sensitivities around body size and shape. Each interviewer kit contained: A weight scale, which was calibrated weekly; a setsquare and measuring tape to measure height; and a measuring tape to measure girth. The participant was asked to remove shoes, hats, any heavy clothes and any heavy items from pockets for this final phase of the interview. No adjustment to the weight measurement was made for clothing. Weight and height were measured and recorded once. Waist and hip circumferences were measured and recorded at least twice.

3.4.6 Changes to Questionnaires

The questionnaires were modified on two occasions in order to reduce respondent burden for those over 75 years of age. Midway through the spring season, these participants were no longer asked about the portion size of the foods in the Food Frequency Questionnaire. Also, Parts 2 and 3 in the Food Frequency Questionnaire, which focused on the use of fat, were eliminated for them as well. In the Provincial Questionnaire, they were asked only whether or not they had consumed the wild foods over the last year, not the frequency or amount of consumption.

For the fall season, the Food Frequency and Provincial Questionnaires were both shortened for all respondents to further reduce respondent burden. In the Food Frequency Questionnaire, the five food items requested by the Ministry of Agriculture, Food and Fisheries were eliminated. In the Provincial Questionnaire, the sections on dental health and food safety were eliminated, as well as two of the questions on physical activity. The two physical activity questions were eliminated since they had not been validated and were causing some confusion for some of the respondents. For the participants over 75 years of age, the two questions on body image and the one question on the physical demands of respondents' work time were eliminated, as these questions were deemed not applicable to older seniors.

3.5 Survey Staff Recruitment and Training

3.5.1 Recruitment

Twenty-nine nurses and nutritionists were recruited as interviewers, including two multi-lingual interviewers (Punjabi/English and Cantonese/Mandarin/English). They were based out of health units working as seconded or contracted staff. Interviewers were primarily responsible for contacting potential participants and conducting in-home interviews. They were also required to review, compile and forward all completed survey materials to their facilitators.

All but two of the interviewers returned for the second season, therefore retention of survey staff between seasons was not an issue. However, four new interviewers were recruited and trained during two and a half intense days for the fall season to lessen and redistribute the workloads more equitably.

Seven dietitian/nutritionists, all health unit staff, were recruited as facilitators. They were responsible for overseeing all aspects of data collection for an assigned team of interviewers. They tracked the progress of interviewers and verified the completed questionnaires prior to forwarding them to the provincial co-ordinator. Through regular contact with the interviewers and in consultation with the provincial co-ordinator, they resolved day-to-day data collection problems.

The provincial co-ordinator completed the complement of staff utilized for data collection. The provincial co-ordinator was a dietitian/nutritionist who worked closely with the principal investigator on the overall co-ordination and implementation of the BCNS. She prepared the training and resource manual and organized the training sessions. She liaised with the facilitators and finished the final verification of the completed questionnaires prior to forwarding them to Health Canada. Assisted by two tracking officers (co-operative education students from University of Victoria, Health Information Science Program), she managed the tracking and reporting of survey progress, following training by Health Canada staff.

The skills, talents and enthusiasm of the survey staff greatly contributed to the success of the BCNS. Health authority employees were utilized if possible in order to provide the opportunity to enhance the research skills of those involved. The choice of experienced, skilled health professionals greatly facilitated the implementation of the BCNS. However, because they typically worked on the Survey part-time while continuing their regular work part-time, they were sometimes challenged to be flexible in responding to the many and varied demands of the BCNS.

A separate qualitative evaluation was conducted to document the strengths and weaknesses of the data collection process and to document experiences of the survey staff. They highlighted the opportunity to meet new people of all ages in the community, to work with teams of supportive and dedicated colleagues and to participate in a major research endeavor outside of their usual work as key benefits of working on the BCNS (Earnshaw et al, 2000).

3.5.2 Training

All survey staff completed eight days of training prior to the Spring season and two days of training prior to the fall season. Health Canada staff, in conjunction with the principal investigator and provincial co-ordinator, developed the training agendas and conducted the training sessions. A training and resource manual, modified from manuals used in previous provincial surveys, was created for the BCNS (B.C.

Ministry of Health, 1999). The spring training session focused on administering the questionnaires and locating and contacting potential participants. It also covered completion of administrative, control and tracking forms. There were many opportunities for practice incorporated into the training schedule.

The two-day retraining session in the fall provided the opportunity to share experiences from the first data collection period; to discuss the changes that had been made to the survey protocol and procedures; and to refresh skills and rekindle team spirit.

Feedback from survey staff on the training sessions and the manual was overwhelmingly positive. However, survey staff did indicate that the training could have been improved by taking into account the background of those participating in the training. For example, nutritionists did not believe that they needed extensive training on how to take detailed food intake records and public health nurses considered themselves to be experts in finding and contacting people in the community. Suggestions for further strengthening the training sessions included a video of the interview process from start to finish and more advice on organizing workloads (Earnshaw et al, 2000).

3.6 Data Collection

The BCNS adapted the survey protocol and standard procedures that were established in earlier provincial surveys. The data collection was divided in two 12-week seasons to account for seasonal variations in eating habits. The spring season was from April 26 to July 18, 1999 and the fall season was from September 20 to December 12, 1999.

3.6.1 Contacting Participants

A letter of introduction from the Ministry was sent to potential participants inviting them to participate in a study of British Columbians' food habits and the factors that influence these food habits. The letter included a message and telephone number (written in French, Punjabi and Chinese) for readers requiring the information in any of these languages. (See Appendix G for a copy of this letter.)

The potential participants were clearly advised in the letter that their participation was voluntary and that they may refuse to answer any questions or to have their body measurements taken. The letter described the importance of the study in terms of enhancing the understanding of eating habits of British Columbians in order to plan food and nutrition programs services in the province.

Each interviewer was provided with lists sorted by postal code by health authority and then sorted alphabetically by last name with the following information:

- Identification number;
- Last name, first name and initial;
- Address;
- Telephone number (if available);
- Sex;
- Date of birth;
- Age/Sex group;
- Age;
- Assigned interview day; and
- Assigned repeat interview day (if applicable).

The lists frequently contained inaccurate and incomplete information and this hampered the interviewers' ability to easily contact potential participants. Many addresses were considerably out of date, particularly for the younger adults who are typically more transient. There was a small number of deceased individuals included on the lists. Errors in postal codes, the basis for sorting, frequently led to misassignment of potential participants to interviewers and subsequent switching of files.

Between the two seasons, the B.C. Health Registry "refreshed" the client data in order to capture changes that occurred since the first file was created. There were several changes, such as death of client (61), moved out of province (12), moved out of survey area (19) and duplicate PHN (1).

Feedback from interviewers revealed that contacting potential participants was the least desirable part of their work. It took all of the their considerable communication skills to obtain interviews from individuals who were resistant to involvement for many reasons including concerns about personal safety, confidentiality, length of interview and confusion about survey purpose (Earnshaw et al, 2000).

The interviewer made a minimum of six attempts by telephone at different times and on different days to reach each individual on the list. The interviewer left a recorded message or a message with the person answering the telephone after the third attempt. If a telephone number was not available, the interviewer tried a minimum of three resources, such as criss-cross telephone directories, health unit databases, personal contacts and home visits.

For each individual on the list, the final status of the interview was coded on a special administrative form called an A1. This form was used to review and report response rate. (See Appendix J for a copy of the A1.)

If the interviewer did not make contact, the file was closed and coded accordingly. In the spring season, once the closed file reached the survey office, the co-ordinator sent a 'request for contact letter' as a last attempt to reach the respondent. In the fall season, the interviewer took over the task of sending out the letter. (See Appendix H for a copy of the letter.)

If the individual refused to participate in the BCNS, the interviewer attempted to complete the non-response questionnaire and the file was closed and coded accordingly. A copy of the non-response questionnaire is in Appendix F. The non-response questionnaire was used to determine if those who refused to participate in the BCNS differed systematically from those who agreed to participate. The non-response questions were administered as part of the demographic questionnaire for participants. The questions dealt with type of bread and milk eaten, vitamin/mineral supplement use, present smoking behaviour, marital status and education level. The reason that these variables were selected for comparison was because earlier studies conducted by Health Canada examined the relationships of these variables (excluding bread consumption and type of bread preferred) and found that they were significant factors that related to the intakes of many nutrients (personal communication, Beth Junkins, Bureau of Biostatistics and Computer Applications Health Canada, January 2002). After completion of this short questionnaire, the potential participant was asked if he/she would like to reconsider his/her decision to not participate in the full interview. Some individuals "converted" at that point but the actual number was not monitored.

If the individual agreed to participate in the BCNS and his/her eligibility for the study was verified (for example, not pregnant or lactating), the interviewer scheduled an appointment. Every attempt was made to schedule the interview on the assigned day. If this was not possible, the interviewer could switch days by following a set protocol. Generally, it was deemed more important to obtain an interview for any day in any region than to lose an interview.

Sometimes, the interviewer determined the individual had moved from the region. If the region was outside of the scope of the BCNS, the file was closed and coded accordingly. If the new address was located in another interviewer's region, the file was switched by following a set protocol.

In other cases, the individual was located but could not participate due to language difficulties, hospitalization/extraordinary illness or extended absence (for example, working at logging or fishing camp or "snowbird"). These files were closed and coded accordingly.

3.6.2 Interviewing Participants

Prior to beginning the interview, the interviewer went through an oral and written process to obtain informed consent from the potential participant. This included asking the individual to read and sign the informed consent form documenting that all information provided during the interview would be held in strict confidence and that any personal identifying information would not appear in any reports. A copy of the consent form is found in Appendix K.

Then, the 24-hour recall was conducted followed, in order, by the food frequency questionnaire, provincial questionnaire and demographic questionnaire. Lastly, height, weight and hip and waist circumference measurements were taken. If an interview had to be "cut short", it was considered a partial interview if the 24-hour recall and demographic questionnaire were completed.

The interviews most commonly took place in participants' homes; however, interviews were also conducted at health unit offices, coffee shops, restaurants and participants' workplaces. All interviewers expressed concerns for their personal safety related to working alone in private homes, however no incidents were reported. Feedback from interviewers indicated that future surveys would benefit from use of cell phones, involving local police in reviewing lists of potential participants and increased publicity about the survey (Earnshaw et al, 2000).

The BCNS was designed to take 1.5 hours in total, however, even in the fall season with shortened questionnaires and experienced interviewers, the average length of the interview was two hours. This increased to an average of 2.5 hours for interviews with seniors.

At the end of the interview, the respondent received a thank you letter from the Ministry and a token gift. Gifts were Heart and Stroke Foundation merchandise, such as key chains, pens and HeartSmart Woman kits and HeartSmart cookbooks, as well as specially designed grocery list note pads.

Interviews were conducted in English throughout the Province. Additionally, in selected communities, interviews were also conducted in Punjabi and Chinese in the spring and in Chinese only in fall. (The decision to discontinue interviews in Punjabi was made based on the low number of unilingual Punjabi surveys conducted in the previous season.) Richmond, Vancouver and Burnaby have a high proportion of people with Chinese or Punjabi as their home language; therefore these communities were targeted (personal communication, David O'Neil, BC Stats, 1998). Letters, consents and questionnaires were all translated into Chinese and Punjabi and multilingual interviewers were employed in order to remove the inability to speak English as a barrier to participation.

3.6.3 Checking Data

Several checkpoints were in place to ensure the accuracy and completeness of the data collected. The interviewer reviewed the forms twice, once at the conclusion of the interview with the participant present and again within 24 hours. All survey forms were then photocopied and the originals were forwarded to the facilitator who checked them a third time. The photocopies were useful for clarification and followup between the facilitator and the interviewer. Any new information obtained was added to the original forms by the facilitator and to the photocopies by the interviewer. The original forms were then forwarded to the provincial co-ordinator who completed the fourth and final check. At the same time, the photocopies were sent from the interviewer to the facilitator for reference. The provincial co-ordinator worked with the facilitator, who in turn worked with the interviewer, to address any queries she had. Any new information obtained was added to the original forms by the co-ordinator and to the photocopies by the facilitator.

In the spring season, every effort was made to adhere to these four checks for every questionnaire, however, the volume of questionnaires made it challenging to meet, particularly the fourth check by the provincial co-ordinator. In the fall, after discussions with Health Canada staff, the protocol for checking data was changed so that the provincial co-ordinator checked approximately one-third of the questionnaires of experienced interviewers and all of the work by the newly-recruited interviewers.

3.6.4 Tracking Forms

Several systems developed by Health Canada were used to manage the many survey and administrative forms. A data control form was used to track all the closed survey files in transit either by courier or by hand-delivery between interviewer and facilitator and between facilitator and provincial co-ordinator. In the fall season, the data control form also served as a tally sheet for monitoring performance of interviewers and facilitators.

A computer-based batch sheet was created to account for all the closed files shipped to Health Canada. The batch sheet listed the identifier number, interviewer number, number of pages of the file and final status of the interview. The batch sheet, which accompanied the shipment, was also faxed to Health Canada to serve as an alert of a pending delivery.

A tracking system was developed to monitor the progress of the BCNS. Of particular interest was the number of files closed each week as a percentage of the total files drawn, the distribution of completed interviews across age/sex groups and the ratio of second interviews to first interviews completed. The tracking officer produced weekly reports for the principal investigator and Health Canada for evaluation and action.

3.7 Data Entry and Analysis

3.7.1 Data Entry

All questionnaires and forms were sent to the Bureau of Nutritional Sciences (BNS) at Health Canada for data entry into the Nutrition Survey System (NSS). The NSS is a custom-designed software program, developed by research staff at the BNS and the Bureau of Biostatistics and Computer Applications to facilitate the entry, processing, storage and retrieval of data on the nutrient and food intakes from the 24-hour dietary recall form and on the many variables from other questionnaires and forms (Administrative form A1; non-response, demographic, provincial and food frequency questionnaires). The NSS is updated and adapted to reflect each provincial nutrition survey.

The NSS uses several databases of foods, mainly the Canadian Nutrient File (Health Canada, 1997) and a recipe database of nearly 3000 recipes, adapted from the USDA CSFII recipe database. The Canadian Nutrient File is a computerized food composition database containing average values for up to 115 nutrients in 4668 basic foods available in Canada. The data are compiled at the BNS of Health Canada. Much of the data in the 1997 version were from the United States Department of Agriculture (USDA) Nutrient Database for Standard Reference, up to and including SR13. Modification for Canadian levels of fortification and regulatory standards, addition of food items only available in Canada and inclusion of some unique Canadian brand names characterize this Canadian standard reference database. The 1999 version, to which values reflecting folic acid fortification of flour and pasta had been added, was used to analyse the BCNS data.

The 24-hour recall data were entered into the NSS by experienced data clerks familiar with food descriptions. The data clerks received training on the specifics of the B.C. survey and were supervised by professional staff to ensure data quality. Problems and questions related to the recorded data that were identified during data entry were relayed to the researchers in B.C. for clarification or correction. Professional staff at the BNS manually checked the data input for each record by comparing a printed copy of the computer-recorded data with the information on the original questionnaire or form.

Input of 24-hour dietary recall data began with the entry of a key name for a food or mixed dish, followed by the selection of the exact or best match to the food or mixed dish from the many options displayed. Existing computerized recipes were used for mixed dishes, with ingredient substitutions or the addition of new recipes as required. Amounts consumed were entered as weights, volumes or coded portion-size models, but all were converted into weights for the output analysis.

Nutrient supplement data were entered by the Drug Identification Number (DIN) or by the name and/or nutrient content if the DIN was not available. When insufficient or inadequate information was provided, the strength of the supplement was selected by default that was determined by BNS staff.

Custom-designed displays were used for the data entry for the other questionnaires and forms. Some automated validations were built-in to ensure a certain degree of consistency and data quality. Questionnaires and forms were entered twice to ensure accuracy. Reports comparing both entries were generated where inconsistencies were highlighted to facilitate corrections.

3.7.2 Data Analysis

The data were analyzed using the statistical software programs, SAS (SAS Institute Inc, Cary, NC) and SPSS (Statistical Package for Social Sciences, version 11.0, Chicago, Ill., 2002). This section briefly describes the method of estimating the distribution of usual nutrient intakes from food sources and supplements, the estimation of the proportion of nutrient inadequacy in the B.C. population and additional analyses conducted by the BCNS research team.

3.7.2.1 Estimating Distribution of Usual Intakes

The method of estimating the distribution of usual intakes from food sources alone is described in the BBCA Technical Report 451311-011 (Appendix L). The method used for the BCNS is an adaptation of the method described by the U.S. National Research Council in 1986. A stratum-adjusted method was then developed and first used for the Nova Scotia Nutrition Survey (Karpinski and Nargundkar, 1992).

This method was peer reviewed by an international panel (Karpinski and Nargundkar, 1992) and evaluated at the Consensus Workshop on Dietary Assessment (1994). A two-step procedure is used: A normalizing transformation is found and then, a linear transformation, which provides a distribution of intakes without the intra-individual component, is used.

The distributions of usual intakes from food sources and supplements were determined using an approach that is further discussed in the BBCA Technical Report 451311-011 (Appendix L) and in more detail in "Methodology for Estimating Usual Intake of Micro-Nutrients from Food and Supplements" (Hayward, 2003, in progress). To determine nutrient intake from food plus supplements, the monthly nutritional supplement use recorded for each participant was expressed as a daily amount and was added to the usual intake obtained from food sources alone. For example, if someone took a multivitamin/mineral supplement containing 50 mg of vitamin C each day and a 500 mg vitamin C supplement 4 times in the past month, the monthly intake from supplements would be 3500 mg (50 mg x 30 + 500 mg x 4). This amount would be averaged over the month (3500 mg/30 = 116.7 mg) and added to the individual's usual vitamin C intake from food to obtain total vitamin C intake.

3.7.2.2 Determining Inadequate Intakes

To estimate the inadequacy of nutrient intakes, the EAR cutpoint method, developed by the Institute of Medicine (Institute of Medicine, 2000b), was used for all nutrients except for iron. A more detailed mathematical approach was used to determine the inadequacy of iron intakes (i.e., the full probability approach). This approach, rather than the EAR cutpoint method, must be used when the requirement distributions are skewed. This is the case for iron. A more detailed description of the method used for iron is explained in Appendices M and N.

3.7.2.3 Influence of Income and Education on Nutrient Intakes

Comparison of survey respondents to non-respondents and to the B.C. population indicated that respondents were better educated and therefore may have had higher incomes. (See Chapter 4.) To determine whether these differences may have biased the results in the direction of more positive findings for nutrient intakes, it was necessary to determine whether education and income were associated with nutrient intakes.

Before analyzing the effects of income and education, these two variables were reclassified. Income levels (n=10) obtained from the BCNS demographic profiles were reclassified as "low income" or "not low

income". This assessment took into account the household income level, the number of occupants living in the household and the breakdown of children and adults living in the household. The "low income" cut-offs were based on the 1999 Statistics Canada low income measures by family type (Statistics Canada, 2001). Education level, which included ten levels in the BCNS demographic profile, was collapsed into three groups: high school or less, trade school or some university and completion of university.

Only nutrients with a measurable prevalence of inadequacy (>10%) were evaluated to assess whether nutrient intakes were influenced by education level or income level. If the prevalence of inadequacy was essentially zero, then an effect of education or income would not be meaningful. To perform the analysis, the unadjusted nutrient intakes were initially transformed logarithmically and outliers were excluded to obtain a reasonably symmetric intake distribution. (Refer to Appendix O.) The possible effects of education and income were then examined using a General Linear Model procedure in SPSS. The dependent variable was the transformed nutrient of interest. The study design elements, including sex, age group, season and geographic strata, were entered as fixed effects, as were the reclassified education and income variables. Unadjusted energy intake was entered as a covariate in each model. Both the main effects and two-way interactions of these variables were determined.

3.7.3 Data Review

One of the conditions of the funding contribution by Health Canada was that prior to publication, the findings of the survey were to be reviewed by an external panel of experts. (See Acknowledgements.) These individuals were provided with a draft of this report and asked to comment on the analysis and interpretation of the data. They were also asked to provide feedback on the clarity and appropriateness of report overall. In appreciation of their time and expertise, the reviewers were offered an honorarium. The peer review process provided detailed comments that were addressed and incorporated in this report.

4.0 Response Rates

Summary

The response rate for the B.C. Nutrition Survey was between 42% and 52%, a rate that is consistent with other provincial nutrition surveys. A comparison of BCNS respondents to non-respondents and the general B.C. adult population was made to determine how representative the results would be of the adult population. Overall, the study participants were higher educated and therefore may have been more health- or nutrition-conscious than the non-respondents as well as the general adult population in B.C. Thus, it is important to investigate the impact that education may have on energy and nutrient intakes.

4.1 Introduction

This chapter summarizes the response rates for the B.C. Nutrition Survey (BCNS). A discussion of how representative the respondents are of the adult population in B.C. is presented. As well, response/non-response comparisons as analyzed by the Bureau of Biostatistics and Computer Applications in the Food Directorate in Health Canada (Appendix P) are included.

4.2 Response Rates for the B.C. Nutrition Survey

The calculation of the response rates was adapted from the Statistics Canada Methods and Standards Committee document *Standards and guidelines for reporting of non-response rates: definitions, framework and detailed guidelines (1992)* and outlined in Figure 4.1. Table 4.1 lists and describes the four response rates that were calculated for the BCNS. The following discussion provides an overview of each of the four response rate categories and whether differences were observed according to age, sex and geographic area.

Table 4.1 Definitions of rates involved in the calculation of response rates for the B.C. Nutrition Survey (BCNS)

Rate	Definition	Equation
Resolved Rate	Number of potential participants located and contacted to participate in the BCNS from the total number of contacts attempted.	$\frac{\text{Number resolved}}{\text{Total attempted}}$
In-scope Rate (eligible)	Number of potential participants successfully contacted that meet the inclusion criteria and thus are eligible over the total number resolved. Out-of-scope means that these individuals are not eligible to participate since they do not meet the inclusion criteria, moved out of province or are deceased.	$\frac{\text{Number in-scope}}{\text{Number resolved}}$
Refusal Rate	Number of potential participants who refused to participated over the number that were successfully contacted and met the inclusion criteria , thus eligible. This rate only includes those individuals who simply refused and does not include those participants who were located but were not able to complete the interviews for various reasons such as language barriers and unsafe environments for the interviewers.	$\frac{\text{Number refusals}}{\text{Number in-scope}}$
Response Rate	The response rate is based on the number of usable first interviews provided by the in-scope individuals and is dependent on if the unresolved individuals were eligible or ineligible to participate. The lower bound of the response rate is calculated assuming that all the unresolved cases were in-scope. The upper bound is calculated assuming that all unresolved cases are out-of-scope.	Lowerbound = $\frac{\text{\# responding - \# unusable}}{\text{\# in-scope + \# unresolved}}$ Upper bound = $\frac{\text{\# responding - \# unusable}}{\text{\# in-scope}}$

Source: BBCA Technical Document 451311-0010NR (Appendix P).

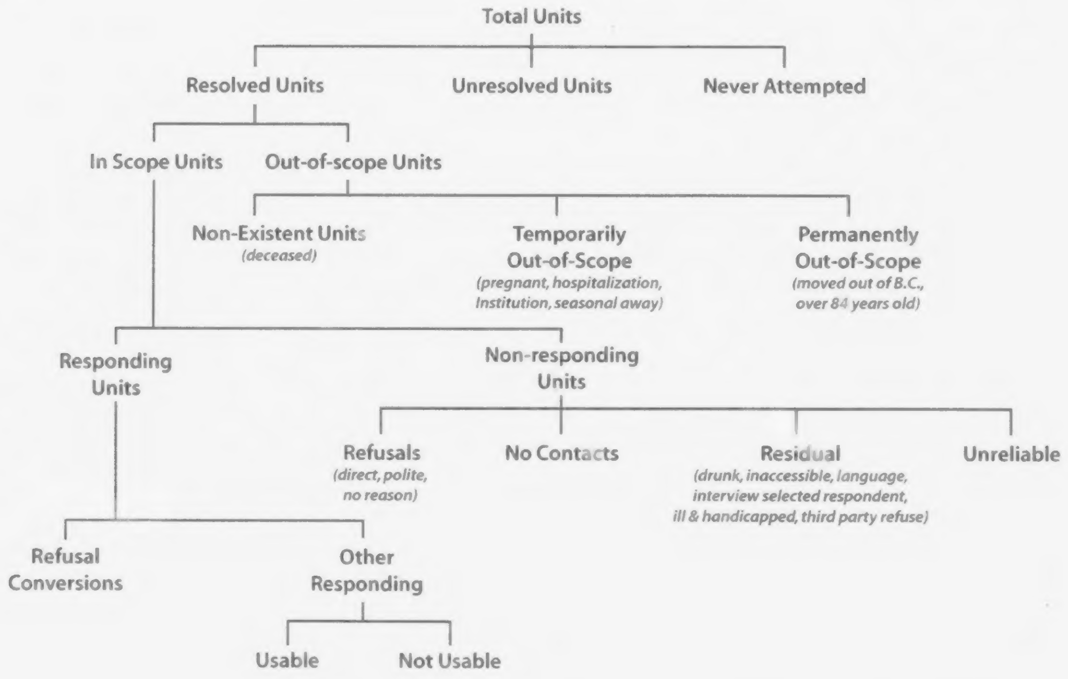

Total Units
Resolved Units
Unresolved Units
Never Attempted
In Scope Units
Out-of-scope Units
Non-Existent Units
(deceased)
Temporarily Out-of-Scope
(pregnant, hospitalization, Institution, seasonal away)
Permanently Out-of-Scope
(moved out of B.C., over 84 years old)
Responding Units
Non-responding Units
Refusals
(direct, polite, no reason)
No Contacts
Residual
(drunk, inaccessible, language, interview selected respondent, ill & handicapped, third party refuse)
Unreliable
Refusal Conversions
Other Responding
Usable
Not Usable

Figure 4.1 Calculation of response rates[1]

[1] Chart adapted from Statistics Canada Methods and Standards Committee (1992) "Standards and Guidelines for Reporting of Non-response Rates: Definitions, Framework and Detailed Guidelines.

Source: BBCA Technical Document 451311-0010NR (Appendix P).

Overall, 82% of the names drawn for the BCNS were resolved – located and contacted to participate. This rate varied across geographic strata with the Metro (79%) and Coastal (81%) strata being lower than the Non-metro stratum (87%). Resolved rates were greater for males than females and lowest in the younger age group but generally increased with age. The pattern with age was expected, as younger individuals are likely to be more mobile than older ones and, consequently, more difficult to track (BBCA Technical Document 451311-0010NR).

Eighty-seven per cent (87%) of the resolved names were in-scope or eligible. Individuals were considered out-of-scope or not eligible if they were dead, moved out of province or exhibited at least one of the exclusion criteria (such as pregnant, lactating, living on-reserve or living in an institution.) (Refer to form A1 in Appendix J.) The in-scope rate was similar between the Metro and Coastal strata (88%) and slightly higher than the Non-metro stratum (84%). The pattern of in-scope rates was the same for both gender groups and appeared to be lowest in the youngest age group (18 - 24 years), increasing with age and dropping off in the older age groups. This pattern was also expected as pregnancy and transient residence affect the in-scope status of the youngest ages, while factors such as severe illness and seasonal residences are prominent in the older groups (BBCA Technical Document 451311-0010NR).

Of those contacted and eligible, 38% refused to participate in the study. The refusal rate varied slightly amongst the geographic strata with Metro stratum having the lowest refusal rate (36%) and Non-metro stratum having the highest (41%). This rate was consistent over the age groups for both genders until 64 years of age, at which point the refusal rate increased for males and decreased for females.

The overall response status for the BCNS by season is presented in Table 4.2. There were 1823 usable responses, 868 in the spring and 955 in the fall. Four hundred and eighty-one repeat recalls were completed, with 230 in the spring and 251 in the fall. Table 4.3 provides the response rates for the BCNS. The response rate is dependent upon the unresolved cases (those individuals that couldn't be reached) and the unusable interviews (for example, incomplete data collection). Upper and lower bounds of the response rate were calculated to account for the proportion of unresolved individuals who were likely to be in-scope. Rates that represent the upper bounds are calculated based on the assumption that all unresolved cases are counted as out-of-scope or ineligible individuals. Alternatively, lower bounds are calculated under the assumption that all unresolved cases represent in-scope individuals. The true rate lies somewhere between these values.

For the BCNS, the lower and upper bounds of the response rate were 42% and 52%. The response rates were similar among the geographic strata ranging from 40% to 44% for the lower bound and from 52% to 53% for the upper bound. Response rates were higher for females than males up to 64 years of age, at which point males had a slightly higher response rate. The response rates increased with age but then decreased in older individuals. For females, the response rate decreased after 64 years and for males, it decreased after 74 years (see Appendix P).

Table 4.2 Response status for the BC Nutrition Survey by season[1]

Summary Status	Spring 1999	Fall 1999	Total
Drawn	2658	2615	5273
Attempted	2397	2502	4899
Resolved (contacted and located)	1965	2044	4009
In-scope (eligible)	1716	1772	3488
Responding with interview	869	957	1826
Response usable 1st recall (% eligible cases)	868 (51%)	955 (54%)	1823 (52%)
Repeat recalls (% of usable 1st recalls)	229 (26%)	250 (26%)	479 (26%)

Source: BBCA Technical Document 451311-0010NR (Appendix P).

[1] Accountability tables by age, sex and geographic stratum are provided in BBCA Technical Document 451311-0010NR (Appendix P).

Table 4.3 Response rates of the BC Nutrition Survey by season and geographic strata

Geographic Stratum	Spring 1999 Response rate				Fall 1999 Response rate				Both seasons Response rate			
	n[1]	LB[2]	n	UB[3]	n	LB	n	UB	n	LB	n	UB
Metro	1022	40%	791	52%	1134	41%	872	53%	2156	40%	1663	52%
Coastal	487.	38%	384	48%	540	44%	430	55%	1027	41%	814	52%
Non-metro Interior	639	43%	541	51%	556	46%	470	54%	1195	44%	1011	53%
All strata	2148	40%	1716	51%	2030	43%	1772	54%	4378	42%	3480	52%

Source: BBCA Technical Document 451311-0010NR (Appendix P).

[1] "n" reflects the number used in the denominator for the response rates equations found in Table 4.1.

[2] LB is lower bound and is the lower bound of the response rate that is calculated assuming that all the unresolved cases were in-scope (eligible).

[3] UB is upper bound and is the upper bound of the response rate that is calculated assuming that all unresolved cases are out-of-scope (ineligible).

4.3 Comparison of B.C. Nutrition Survey Respondents to Non-respondents

A low response rate suggests the potential for bias. Non-responders may differ from survey responders suggesting a non-response bias and results that may not be reflective of the general adult population in B.C. In an effort to determine the direction and/or extent of potential bias introduced with a low response rate, researchers with the BCNS obtained demographic and selected available data on both non-responders and respondents to determine whether differences exist between the two groups. In the BCNS, the non-responders were asked to complete a short survey including questions on smoking, consumption of bread, milk and supplements, education and marital status.

About 66% of the non-respondents were willing to answer this survey. Their responses to the questions were compared to the responses obtained from the study participants. The results are presented in Table 4.4 and summarized in this section.

Table 4.4 Comparison of B.C. Nutrition Survey responders to non-responders

Characteristic	**Responders**		**Non-responders**	
	n	**%**	**n**	**%**
Daily smokers:				
All	1806	16.7*	863	23.4
Males	860	16.7	427	24.8
Females	946	16.7	436	22.0
Bread consumers: (All)	1809	98.9	874	98.5
Bread consumption				
By type (All):	1790		861	
Whole wheat		49.7		51.0
Multigrain		23.7		24.4
White bread		17.5		13.7
Rye, pumpernickel		4.8		4.6
Other		4.1		5.2
Don't know		0.1		0.8
Milk consumers:				
All	1809	94.6*	876	89.4
Males	860	92.7	432	88.9
Females	949	96.3	444	89.9
Milk consumption				
By type (All):	1711		783	
Whole		10.5		13.2
2%		43.0		44.4
1%		24.3		23.8
Skim		16.2		14.2
Powdered		0.8		1.2
Evaporated		1.2		0.6
Other		4.0		2.3
Don't know		<0.1		0.3
Vitamin/mineral supplement usage:				
All	1809	66.2*	874	59.8
Males	860	60.2	431	53.1
Females	949	71.7	443	66.4

Table 4.4 continued

Characteristic	Responders		Non-responders	
	n	%	n	%
Education (Bachelor degree and above):				
All	1808	14.4*	861	9.2
Males	860	16.2	423	11.8
Females	948	12.9	438	6.6
Marital status				
Married:				
All	1806	65.2	861	64.1
Males	858	70.0	422	69.2
Females	948	60.8	439	59.2
Single:				
All	1806	15.1	861	16.5
Males	858	16.9	422	19.2
Females	948	13.5	439	13.9
Widowed:				
All	1806	10.2	861	11.7
Males	858	5.6	422	4.5
Females	948	14.3	439	18.7
Divorced/separated:				
All	1806	9.6	861	7.7
Males	858	7.5	422	7.1
Females	948	11.4	439	8.2

Source: BBCA Technical Document 451311-0010NR (Appendix P).

*Indicates a significant difference between the responders and the non-responders.

The results show that there were significantly fewer smokers, more vitamin/mineral supplement users and more postgraduate degree holders in the respondents than the non-respondents and these findings are consistent over age and sex groups. Respondents reported higher proportion of milk consumers for both sexes and for those 45 years and over. There was little effect of the type of milk consumed, but a slight trend to lower fat milk preference for study participants. There were no significant differences regarding marital status or bread consumption between the two groups.

4.4 Comparison of B.C. Nutrition Survey Participants to the B.C. Adult Population

To determine whether the findings in the BCNS are representative of the general adult population, BCNS participants were compared to B.C. adult population in terms of factors such as smoking, education and marital status using B.C. population statistics and the demographic information obtained from the study participants. The results, as shown in Table 4.5, suggest that the participants in the BCNS had similar smoking status, were more educated and a higher proportion were married than the general B.C. population.

Table 4.5 Comparison of the BCNS respondents to BC population profiles[1]

Characteristic	Group	BCNS Respondents		B.C. Population Profile	
		Weighted Proportion	n	Weighted Proportion	n
Smokers[2]	All	16.9	1806	17.3	1722
	Males	17.3	860	17.9	790
	Females	16.5	946	16.8	932
Education[3]	Males (all ages)		860		not applicable
Secondary school or less		33		57	
Trade or College		21		27	
Some University		26		3	
Completed University		21		13	
	Females (all ages)		948		
Secondary school or less		34		52	
Trade or College		20		30	
Some University		28		2	
Completed University		18		16	
Marital Status	Males (all ages)		858		not applicable
Married		64		55	
Single		28		23	
Separated/divorced		7		13	
Widowed		2		9	
	Females (all ages)		948		
Married		60		58	
Single		20		30	
Separated/divorced		12		10	
Widowed		9		2	

Source: BBCA Technical Document 451311-0010NR (Appendix P).

[1] All survey estimates are weighted by sample weights to ensure that the responders contribute to estimates proportionally with respect to age and sex to be representative of the general population.

[2] The smoking statistics are from the Canadian Tobacco Use Monitoring Survey (CTUMS, January 1999), a national survey sponsored by Health Canada and conducted by Statistics Canada. The BC specific CTUMS results were provided by personal communication from M. de Groh, Health Canada, January 2002.

[3] The education and marital status statistics are from the 1996 Census.

4.5 Discussion

The overall response rate for the BCNS was between 42% to 52%. This rate is within the range of response rates achieved by other provincial nutrition surveys (BBCA Technical Report 451311-006NR, Junkins, 1999). Some reasons for non-response include the time commitment, safety and security concerns, particularly on the part of the seniors' population, mobility trends of younger adults and inaccuracies in the sampling frame.

Cigarette smoking has been linked to certain nutrition behaviours in that smokers tend to have food and nutrient intakes that differ from the dietary guidance recommendations (Berger and Wynder, 1994). The proportion of daily smokers was significantly different between responders and non-responders. However, when compared to the data from the Canadian Tobacco Use Monitoring Survey, the smoking rates of the BCNS participants did not differ from the general B.C. adult population. This suggests that any related bias in the nutrient intake results will probably be small and difficult to detect.

Bread, milk and vitamin and mineral consumption were examined for the responders and non-responders. A significantly higher proportion of responders took a vitamin and mineral supplement. These results suggest that there may be a tendency for the prevalence of milk and supplement consumption to be high from the survey.

The over-representation of university education between BCNS participants and non-respondents as well as the general population may introduce significant bias towards nutrition recommendations and effect the results. It has been reported that groups with higher education will have lower smoking rates, lower alcohol and meat consumption but higher fruit, vegetable and supplement intakes (Berger and Wynder, 1994). For this reason, the effects of education and income on energy and nutrient intakes were examined.

5.0 Demographics

Demographic and Other Characteristics of British Columbians

Summary

Most of the BCNS participants were married, food secure, did not hold a university degree, did not smoke and were not classified as low income. More than half were overweight or obese, similar to what is found nationally. As well, 64% were consuming either nutritional or non-nutritional supplements or both, higher than what has been documented in previous surveys conducted in Canada and the U.S. These results provide more evidence that weight issues are a concern for the B.C. population and that more research is needed to explore consumers' perception about supplement use and to understand the consequences of increased supplement use. Even though most participants were food secure, the Canadian Community Health Survey and the BCNS both show that some British Columbians are dealing with food insecurity.

5.1 Introduction

A description of the B.C. adult population as assessed in the BCNS is provided in this chapter. Some of the characteristics presented here are from information in the Demographic Questionnaire (Appendix D) including sex, aboriginal/First Nations origin, marital status, education level, income level, household size and smoking status. Other information such as body mass index (BMI), supplement use and food security issues are from the Anthropometric Measurements, the 24-hour Dietary Recall (Appendix B) and the Provincial Questionnaire (Appendix E).

5.2 Selected Demographic Characteristics of the BCNS Participants

A number of the demographic characteristics of the BCNS participants are depicted in Table 5.1. There was similar representation of females and males in the BCNS. Two-thirds of the participants were married, 15% had completed a university degree and 17% were smokers. Since aboriginal people living on Indian reserves were excluded from the survey, it is not surprising that only a small proportion (3%) of participants were of Aboriginal or First Nations origin.

Table 5.1 Demographic characteristics of the BC Nutrition Survey participants (n=1823)*

Characteristic	Total	Males	Females
Gender	n=1823	47.6% (n=868)	52.4% (n= 955)
Education Level:			
Completed high school or less	40.7%	40.3% (n=347)	41.1% (n=390)
Technical school/some university	44.8%	43.5% (n=374)	46.0% (n=436)
University Degree	14.6%	16.2% (n=139)	12.9% (n=122)
Marital Status:			
Married or Common Law	65.2% (n=1806)	70.0% (n=858)	60.8% (n=948)
Divorced/separated	9.6%	7.5%	11.4%
Widowed	10.2%	5.6%	14.3%
Single	15.1%	16.9%	13.5%
Aboriginal/First Nations	2.9% (n=53)	3.1% (n=27)	2.7% (n=26)
Smokers	16.5% (n=301)	16.6% (n=144)	16.4% (n=157)

*Data are unweighted.

5.3 Income Status and Food Security Issues of the B.C. Population

Since lower socio-economic status may influence nutrient intakes and food insecurity, the income levels obtained from the BCNS Demographic Questionnaire were recalculated to determine the proportions of the population who would be classified as low income or not. Of the 1450 participants who answered the income question (20% did not provide a response), 25% were classified as low income (Table 5.2). This proportion is slightly more than the 19.6% reported in the 1996 census for the B.C. population.

In the BCNS, participants were asked three questions associated with food insecurity regarding lack of quantity and/or quality of food and if they were ever "worried" during the past 12 months that they didn't have enough to eat because of lack of money. The findings are presented in Table 5.2. The result for the question on quality and variety of food is similar to what was found for B.C. in the 2001/02 Canadian Community Health Survey (CCHS). However, there are small differences for the "worried" and the "quantity" questions, with fewer BCNS participants answering yes to these questions. The reason for the discrepancy in numbers could be due to sampling variation. The CCHS targeted British Columbians from 12 years and over whereas the

BCNS only targeted the adult population. As well, differences could be due to the interpretation of the different response options for the questions in the two surveys. For instance, in the CCHS respondents were instructed to answer often, sometimes and never to these questions and a positive response was considered if the respondent answered often or sometimes. However, in the BCNS participants were instructed to answer simply yes or no. When income levels were examined, as one might expect, slightly more than half of those who responded yes to the 'worried' (59.8 %) and "quality" (53.7 %) questions were classified low income and the majority of those who said yes to the "quantity" question (73.8 %) were low income. Even though the proportion of the province that has compromised food intakes is low, these results indicate some British Columbians are experiencing food insecurity.

Table 5.2 Income status and food security of the survey participants compared to the BC population.

Characteristic	**BCNS (%)**	**B.C. (%)**
Low income status (n=1450)	25.2	19.6[1]
Received income from income assistance or welfare	5.9	4.3[2] (19-64 years)
Worried that there would not be enough to eat because of lack of money	7.3	11.6[3]
Did not have enough food to eat because of lack of money	3.4	8.2[3]
Did not eat the quality or variety of foods because of lack of money	12.0	14.8[3]
OF THOSE WHO ANSWERED "YES" TO ANY OF THE THREE QUESTIONS ABOVE:		
Skip meals or eat less than you should because there was not enough money for food (at least once per month)[4]	19.2	
Eat cheaper foods or the same foods for several days because there was not enough money for food (at least once per month)[4]	38.1	
Receive food from a food bank, soup kitchen or other charitable agency because there was not enough money for food (at least once per month)[4]	5.6	

Data is weighted.

[1] Statistics Canada, Census 1996.

[2] BC Statistics from Ministry of Human Resources.

[3] BC statistics calculated from positive responses of participants in the Canadian Community Health Survey, 2002.

[4] These questions were asked to participant who answered yes to any of the three food security questions – worrying about not having enough to eat because of lack of money, not having enough to eat because of lack of money and not eating the quality or variety of foods because of lack of money. The response reported is at least monthly.

5.4 Body Mass Index (BMI) of the B.C. Population

The prevalence of overweight and obesity in the adult population is increasing in B.C. and has become a serious health concern. According to Table 5.3, about 37% of the participants were considered overweight (BMI ≥ 25.0 - 29.9) and almost 18% were classified as obese (BMI ≥ 30). This proportion is higher than what was estimated in the 1989 Heart Health Survey for the B.C. population. The results of these two surveys are comparable, since they both used measured heights and weights. In 1989, 45% of the population had a BMI ≥ 25, compared to 55% in the BCNS, resulting in a 10 percentage point increase over the last 10 years. Additional information on BMI will be presented in the *Report on Physical Activity and Body Weight.*

Table 5.3 Percent distribution (%) of Body Mass Index (BMI)[1] by age and sex

BMI	Total	Males 19-30	Males 31-50	Males 51-70	Males 71+	Females 19-30	Females 31-50	Females 51-70	Females 71+
<20	6.3	8.6	1.3	2.6	1.5	13.2	6.3	10.6	4.7
≥20 to <25	39.3	43.1	27.4	29.3	22.4	51.6	53.3	33.6	38.3
≥25 to <27	18.2	15.0	29.4	29.4	22.5	10.4	10.5	12.7	15.7
≥27 to <30	18.4	20.8	22.1	19.0	28.2	13.1	12.9	19.7	20.4
≥30	17.8	12.4	19.9	19.8	25.3	11.6	17.0	23.4	20.9

[1] 87.5% were measured heights and weights.

Source: BBCA E451311-011BV1 - S. Hayward, August 2002.

The shaded area represents the healthy weight range and the proportion of the population that falls within this range.

5.5 Supplement Usage by the B.C. Population

The use of nutritional and non-nutritional supplements is becoming more and more popular in North America. Findings from the recent Food Habits of Canadians survey estimated the prevalence of use of nutritional supplements to be 47% among women and 33% among men, with 41% of the population using at least one vitamin or mineral supplement (Troppmann et al. 2002). In the U.S., the results are similar, with about 40% of the population taking dietary supplements (NHANES III). These studies have found that more women, older adults and households with higher incomes are the groups more likely to take these supplements (Troppmann et al. 2002; NHANES III, Statistics Canada, 2003).

Information about the usage of non-nutritional supplements is limited. Data from NHANES III found that the two most frequently used products were garlic and lecithin (Radimer et al. 2000). As well, use of these supplements was similar across most age groups, however, there seemed to be a higher proportion of users aged 45-74 years. For the BCNS, the most common non-nutritional supplements were glucosamine, echinacea, garlic, ginkgo, lecithin, evening primrose, ginseng, coenzyme Q10 and St John's Wort.

In the BCNS, participants were asked if they consumed supplements yesterday and how often during the past month. Supplements were classified as nutritional (containing recognized vitamins and minerals) and non-nutritional supplements (not containing recognized vitamins and minerals but considered by the respondent to be a supplement). Sixty-four percent of the total population were consuming supplements, with the trend increasing with age for both men and women (Table 5.4). A total of 57% of the population was consuming nutritional supplements, which is appreciably more than the national figure reported (40%). As presented in Table 5.5, the most common supple-

Table 5.4 Proportion of population taking supplements last month by sex and age

Supplement	Total (%)	Males (%)				Females (%)			
		19-30 yr	31-50 yr	51-70 yr	71+ yr	19-30 yr	31-50 yr	51-70 yr	71+ yr
Nutritional only	31	33	27	28	29	34	31	29	40
Non-nutritional only	7	9	9	9	4	4	6	4	4
Both nutritional and non-nutritional	26	13	16	23	37	24	32	45	40

Source: BBCA E451311-011CV1-Supplement Tables - S. Hayward. August 2002 ments consumed were those containing a mixture of vitamins and minerals (31%), vitamin C (24%), herbs and natural products (19%) and vitamin E (17%). The number of supplements taken yesterday by the population was also explored and the results are shown in Table 5.6. One-quarter of the population, who took supplements, consumed four or more nutritional supplements in one day, while almost 39% took four or more of a combination of nutritional and non-nutritional supplements. The proportion of multiple supplement use was highest for men over 70 years of age and all women 31 years and over. Additional information on supplement use will be presented in a separate report.

Table 5.5 Proportion of population taking supplements last month by supplement groups, sex and age

Supplement Group	Total (%)	Males (%)				Females (%)			
		19-30 yr	31-50 yr	51-70 yr	71+ yr	19-30 yr	31-50 yr	51-70 yr	71+yr
Iron preparations	1	0	0	<1	5	2	3	<1	1
Replacement preparations	2	0	1	1	7	<1	1	5	9
Enzymes	<1	0	0	1	0	<1	0	<1	0
Gastrointestinal products	5	2	2	3	2	4	8	8	7
Vitamin A	2	2	2	4	1	1	<1	3	6
Vitamins A and D	3	0	1	2	8	2	3	7	10
Vitamin B complex	9	2	5	8	15	9	12	16	12
Vitamin C	24	19	22	16	29	25	28	30	24
Vitamin D	1	0	<1	2	1	0	<1	3	5
Vitamin E	17	4	9	22	38	6	14	35	40
Multivitamins	9	7	11	4	7	12	8	14	10
Vitamins and minerals	31	23	21	24	29	30	42	37	54
Minerals	13	4	6	12	13	8	18	28	23
Other nutrients	20	11	17	18	25	8	27	33	29
Herbs and natural products	19	10	11	19	25	21	25	25	26
Homeopathic	3	<1	<1	2	3	5	3	4	5

Source: BBCA E451311-011CV1-Supplement Tables - S. Hayward, August 2002.

Contains mostly calcium and potassium.

Includes antacids, adsorbents, laxatives, digestants.

Includes glucosamine, amino acids, evening primrose oil, coenzyme Q10, flax seed oil, lactic acid bacteria.

Table 5.6 Number of supplements taken by supplement users in one day by sex and age

Supplement	Total (%)	Males (%)				Females (%)			
		19-30 yr	31-50 yr	51-70 yr	71+yr	19-30 yr	31-50 yr	51-70 yr	71+ yr
Nutritional:									
1	34.8	67.9	42.6	41.9	34.7	48.4	35.6	28.3	23.4
2	23.4	14.3	24.6	26.5	24.4	26.7	21.2	21.2	24.0
3	16.5	3.6	13.1	13.7	14.8	14.1	18.6	16.7	22.8
4	10.8	10.7	14.8	8.6	12.5	6.3	5.1	14.7	10.2
5	5.9	3.6	1.6	2.6	8.0	0.0	5.9	8.6	7.2
≥6	8.7	0.0	3.3	6.8	5.7	4.7	13.6	10.6	12.6
Nutritional and Non-nutritional:									
1	26.4	55.9	36.1	29.7	25.7	42.9	23.4	20.1	18.3
2	19.0	17.7	20.8	21.1	16.0	17.1	25.8	16.4	19.4
3	16.0	8.8	15.3	18.0	13.9	17.1	18.6	17.3	14.9
4	10.7	5.9	8.3	11.7	11.2	10.0	3.2	12.6	14.3
5	8.0	2.9	9.7	4.7	11.8	5.7	4.8	6.5	11.4
≥6	19.9	8.8	9.7	14.8	21.4	7.1	24.2	27.1	21.7

Source: BRCA E451311-011CV1-Supplement Tables S. Hayward, August 2002.

6.0 Energy and Nutrient Intakes

Summary

Energy and nutrient intakes were estimated for British Columbians in eight age and gender groups from the BCNS data. Energy intakes for British Columbians were lower than estimated requirements. Most British Columbians are making progress toward meeting the dietary guidance for macronutrients – fat, carbohydrate and protein. However, about one-fifth were below the lower end of the recommended range for carbohydrates (<45% of calories) and almost one-quarter consumed more than 35% of their calories from total fat. Half of the population were consuming more than 10% of their calories from saturated fats. The majority of the population consumed less than 300 mg of cholesterol per day, indicating that British Columbians have made an attempt to lower their cholesterol levels to what had been recommended previously. In addition, the median fibre and calcium intakes were considerably less than the Adequate Intake (AI), making both priority issues for the public health agenda. Micronutrients that are potential public health concerns due to inadequacy of intake include folate, vitamins B6, B12 and C, magnesium and zinc. Another issue of concern is inadequate iron intake for pre-menopausal women. Continued monitoring is essential and further research is needed to determine the implications of inadequate and/or excessive intakes of both macro- and micro-nutrients.

6.1 Introduction

The intent of this chapter is to provide information on the nutrient intakes of British Columbians and to help identify and target potential nutrition concerns in this population. This chapter examines energy and nutrient intakes of the British Columbian adult population according to sex and the age groups used for determining the Dietary Reference Intakes[1] (19-30 years, 31-50 years, 51-70 years and 71 years and over). The effects of educational level, low income status and geographic strata on intakes are not included in this discussion. Appendix O provides the results of analyses that examined the effect of these three factors on the consumption of nutrients of concern. Low income status and geographic strata did not have an effect on consumption of these nutrients. Educational attainment only had an effect on the intakes of vitamins C and B12. It appears that vitamin C intake is higher and vitamin B12 intake is lower for those British Columbians who have a higher level of education. In addition, the lack of an effect of education attainment for most of the other nutrients of concern was partic-

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[1] The Dietary Reference Intakes were reviewed in the literature review (Chapter 2).

ularly important, since it has implications for the extent to which the results can be generalized to all British Columbians. Although the sample was better educated than the B.C. population, the lack of a positive association between educational level and consumption of most of the nutrients of concern suggests that this difference does not bias the results.

Tables were generated using data presented in the technical reports provided by Health Canada (BBCA E451311-011BV1, BBCA E431311-011CV1) and following further manipulations of the raw data as determined by the BCNS research team. The 1999 Canadian Nutrient File (CNF) was used for determining the nutrient content of foods consumed by British Columbians. This database is almost 100% complete for energy and macronutrients and 90% or more complete for the other nutrients presented in this report. Those amounts that are missing for the nutrients presented are felt to provide negligible contributions and can be reasonably set at zero (personal communications with Beth Junkins and Josie Deeks, December 2002). Vitamins D and E intakes are not included in this report since the 1999 CNF is incomplete for these two nutrients. Furthermore, vitamin A intakes are not included in this report because comparison of the results to Dietary Reference Intakes is not possible at this time. A different unit is used in the CNF (retinol equivalents, RE) than the one used for the estimation of the EAR (retinol activity equivalents, RAE) and until the RE can be transformed to the RAE, any comparison with the EAR will overestimate adequacy.

The tables presented in this chapter include the mean adjusted nutrient intakes (adjusted for intrasubject variability) and distributions of nutrient intakes from food sources alone and from food sources and supplements where applicable. As well, intakes were assessed against the Estimated Average Requirement (EAR), Adequate Intake (AI) and the Tolerable Upper Intake Level (UL), when possible, to determine inadequacies or issues of over consumption in the B.C. population. For nutrients with an EAR, the percentage below the EAR reflects the prevalence of inadequacy with respect to the criterion used to set the EAR. For nutrients with an AI, the prevalence of nutrient inadequacy cannot be quantitatively determined. However, when median usual intake of a group meets or exceeds the AI, the expected prevalence of inadequacy is low. This is particularly true when the AI was set as the median intake of a healthy group. When reviewing these assessments, the reader should keep in mind that the new Dietary Reference Intakes (DRIs) were established on the basis of reducing the risk of chronic disease and not only to prevent deficiencies as was done previously. Appendix Q provides a list of the criteria used to establish the new DRIs to assist the reader in the understanding of this concept and, thus, the assessments.

Some comparisons are made to the results of the Third National Health and Nutrition Examination Survey[2] (NHANES III) and the Continuing Survey of Food Intakes of Individuals (CSFII). Appendix R includes tables that present median usual intakes of the U.S. adult population from food alone and from food plus supplements according to the data obtained from NHANES III and CSFII. However, comparisons to the findings of the published provincial nutrition surveys are not included since the BCNS used a new coding system, a more recent version of the Canadian Nutrient File, different age groupings and the new DRIs as the reference standards for assessment. Furthermore, there is a separate initiative underway by Health Canada to facilitate inter-provincial comparisons of nutrient intakes. BCNS results will contribute to this initiative.

6.2 Energy and Macronutrients

6.2.1 Energy

Energy intakes and possible estimates of total energy expenditure (TEE) are shown in Table 6.1. For both males and females, energy intakes decreased with age, as one would expect since older individuals tend to have lower energy requirements. The formulas used to determine energy requirements (TEE) are presented in footnotes 2 and 3 of Table 6.1. These formulas are derived from data obtained using the doubly labeled water technique and use participants' measured heights and weights and a physical activity coefficient (PA) assuming that participants are sedentary or engaged in low levels of activity (Institute of Medicine, 2002). These two PAs were used since it has been previously documented that the majority of Canadians are relatively inactive (Katzmarzyk et al, 2000).

When comparing the intakes of British Columbians to their crudely estimated requirements, it was encouraging that mean energy intakes seem to be only slightly under-reported for most of the age groups and in particular for men. Under-reporting of energy intakes is consistent with the literature (Lee and Nieman, 2003). Even when using a standardized method such as the multiple pass 24 hour recall method and providing extensive training to interviewers as was done for the BCNS, research has shown that respondents with low food consumption tend

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[2] An ongoing nutrition surveillance system in the US that uses the mulit-pass 24 hour recall was used in the BCNS and assesses intakes using the DRI age groupings.

to overestimate their intake and those with high consumption underestimate intake, a phenomenon known as "flat-slope syndrome". Overall, the literature suggests that recalls tend to underestimate intake by about 10%-20% compared with observed intake (Buzzard, 1998). Underreporting of energy intakes was also observed in NHANES III (Briefel et al, 1997).

Table 6.1 Energy intakes (kcal) by sex and age

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles 25th	Percentiles 50th	Percentiles 75th	TEE[2,3] Sedentary Mean ± SEM	TEE[4,5] Low Activity Mean ± SEM
Male	19-30	142	2883 ± 105	2167	2824	3452	2664 ± 13	2907 ± 15
	31-50	205	2624 ± 71	2155	2644	2912	2584 ± 15	2837 ± 17
	51-70	249	2342 ± 74	1898	2334	2703	2340 ± 20	2588 ± 22
	71+	271	2013 ± 64	1627	1894	2285	2162 ± 26	2405 ± 29
Female	19-30	176	1971 ± 72	1667	1875	2125	2028 ± 12	2282 ± 13
	31-50	266	1812 ± 49	1515	1763	2012	1901 ± 11	2155 ± 12
	51-70	282	1669 ± 42	1422	1610	1826	1773 ± 13	2029 ± 15
	71+	230	1508 ± 35	1317	1502	1633	1590 ± 17	1837 ± 19

Source: BBCA E451311-011BV1 - S. Hayward, August 2002.

[1] SEM= Standard Error of the Mean.

[2] TEE sedentary for men=Total Energy Expenditure for those who are sedentary, estimated using the following formula=662-9.53 x Age (yr) +PA x (15.91 x Weight [kg] + 539.6 x Height [m]), where PA is the physical activity coefficient and equal to 1.0.

[3] TEE sedentary for women=Total Energy Expenditure for those who are sedentary, estimated using the following formula=354 – 6.91 x Age (yr) +PA x (9.36 x Weight [kg] + 726 x Height [m]), where PA is the physical activity coefficient and equal to 1.0.

[4] TEE low activity for men=Total Energy Expenditure for those whose activity is low (defined as TEE/BEE of 1.4-<1.6), estimated using the following formula=662-9.53 x Age (yr) +PA x (15.91 x Weight [kg] + 539.6 x Height [m]), where PA is the physical activity coefficient and equal to 1.11.

[5] TEE low activity for women=Total Energy Expenditure for those whose activity is low, estimated using the following formula=354 – 6.91 x Age (yr) +PA x (9.36 x Weight [kg] + 726 x Height [m]), where PA is the physical activity coefficient and equal to 1.12.

Mean values for the proportion of energy derived from alcohol and macronutrients for the total population and by age and sex are presented in Table 6.2a. Table 6.2b presents the distribution of energy derived from macronutrients and the shaded areas in the table represent the Acceptable Macronutrient Distribution Ranges (AMDR), where appropriate. The AMDRs are the new dietary guidance recommendations that were based on chronic disease prevention and ensuring adequate intakes of essential nutrients. These are 45 to 65 percent of energy from carbohydrates, 20 to 35 percent from fat and 10 to 35 percent from protein.

The proportion of B.C. adults falling within the AMDR appears to be consistent for the two sexes and across age groups. However, there was an appreciable proportion of the population (about one-fifth) not consuming 45% of their total energy from carbohydrate and almost one-quarter of the population consuming more than 35% of total energy from total fat. In addition three-quarters of the population were consuming less than 5% of their energy from linoleic acid and more than 10% of their calories from saturated fats. Seventy percent were consuming the recommended range for α-linolenic acid. Health implications of having high intakes of total fats, saturated fats and cholesterol (to be discussed in section 6.2.5) include high blood lipid levels and the risk of developing cardiovascular disease.

Table 6.2a Percentage (%) of energy derived from alcohol, carbohydrate, fat and protein by age and sex

Nutrient	**Total**	**Males**				**Females**			
		19-30 yr	**31-50 yr**	**51-70 yr**	**71+ yr**	**19-30 yr**	**31-50 yr**	**51-70 yr**	**71+ yr**
Alcohol	2.7	2.6	3.4	3.1	3.3	2.5	2.0	2.2	1.9
Carbohydrate	49.8	50.0	48.5	49.1	49.9	52.8	48.9	50.0	51.9
Fat	31.9	30.9	32.5	31.8	31.7	30.9	33.5	31.5	29.6
Protein	15.6	16.5	15.5	15.9	15.1	13.8	15.5	16.3	16.6

Source: BBCA E451311-011BV1 S. Hayward, January 2003.

Table 6.2.b Distribution of energy derived from carbohydrate, total fat, linoleic acid, α-linolenic acid, saturated fat and protein for the total population and by sex and age (expressed as a percentage (%) of energy)[1]

Nutrient	Total	Males				Females			
		19-30 yr	31-50 yr	51-70 yr	71+ yr	19-30 yr	31-50 yr	51-70 yr	71+ yr
Carbohydrate									
< 45% of Energy	22	18	34	23	26	9	23	18	14
≥ 45 to < 55	54	60	43	57	48	51	60	57	49
≥ 55 to < 65	22	21	20	16	23	37	16	24	35
≥ 65	2	2	4	4	3	3	0	1	3
Fat									
< 20% of Energy	1	0	1	1	1	0	2	2	7
≥ 20 to < 25	9	4	6	9	16	16	6	16	15
≥ 25 to < 30	29	40	25	24	23	36	26	26	36
≥ 30 to < 35	36	41	41	45	31	29	30	34	29
≥ 35 to < 40	19	12	23	16	23	14	25	16	8
≥ 40	6	3	4	5	6	5	10	7	4
Linoleic Acid									
< 5% of Energy	76	81	67	61	72	84	77	85	90
≥ 5 to < 10	24	19	33	38	28	16	23	16	10
≥ 10	<1	0	0	1	<1	0	0	0	0
α-Linolenic Acid									
< 0.6% of Energy	23	40	23	33	22	32	13	10	10
≥ 0.6 to < 1.2	70	50	71	54	71	66	83	79	85
≥ 1.2	7	10	6	14	7	1	4	11	4
Saturated Fat[2]									
< 5% of Energy	2	0	1	0	5	1	1	2	8
≥ 5 to < 10	51	55	48	49	53	61	44	50	58
≥ 10 to < 15	43	45	49	47	35	33	49	42	27
≥ 15 to < 20	4	0	2	4	5	4	6	5	6
≥ 20	0	0	0	0	2	0	0	1	1
Protein									
<10% of Energy	2	3	2	1	2	7	1	0	0
≥ 10 to < 20	92	87	88	94	95	91	92	98	97
≥ 20to < 30	6	11	10	6	3	2	7	2	3
≥ 30	0	0	0	0	0	0	0	0	0

[1] The shaded areas represent the Acceptable Macronutrient Distribution Ranges (AMDR) where appropriate and the proportion of the population meeting these recommendations.

[2] No AMDR is set for saturated fats.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

6.2.2 Carbohydrate

Carbohydrate intakes are presented in Table 6.3. The median intake ranged from 248-342 g/d for men and 197-257 g/d for women and is slightly higher than the U.S. data (Appendix R). The Estimated Average Requirement (EAR) is set at 100 g/d and is based on the amount of carbohydrate needed to produce enough glucose for the brain to function (Institute of Medicine, 2002). As noted in Table 6.3, virtually no one in the B.C. population was below this amount.

Table 6.3 Carbohydrate intakes by sex and age (expressed as g/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles 25th	50th	75th	EAR[2]	%<EAR
Male	19-30	142	365 ± 17	272	342	423	100	0
	31-50	205	323 ± 10	251	316	381	100	0
	51-70	249	293 ± 10	222	288	343	100	0
	71+	271	254 ± 8	204	248	282	100	0
Female	19-30	176	265 ± 9	231	257	276	100	0
	31-50	266	226 ± 7	189	219	249	100	0
	51-70	282	213 ± 6	178	210	244	100	<1
	71+	230	201 ± 5	176	197	220	100	0

[1] SEM= Standard Error of the Mean.

[2] EAR = Estimated Average Requirement.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

6.2.3 Dietary Fibre

Fibre helps promote a healthy digestive system and there is evidence to suggest that it may play a role in the prevention of colon cancer and promotion of weight control, although the data are inconclusive at this point (Institute of Medicine, 2002). An Adequate Intake (AI) for dietary fibre is set at 38 g/d and 25 g/d for men and women aged 19-50 years, respectively and at 30 g/d and 21 g/d for men and women over 50 years of age. These AIs are based on the amounts needed to help protect against coronary heart disease, for which there is the strongest evidence of a protective role (Institute of Medicine, 2002). The median intakes for fibre for both men and women in B.C. (Table 6.4) are similar to what has been reported in the U.S. (Institute of Medicine, 2002). It is important to note that intakes may be underestimated by about 5g/d, since the database for fibre does not include the contributions of inulin and fructo-oligosaccharides. According to the Continuing Food Survey of Intakes by Individuals, these types of fibre could contribute about 5 g/d in the adult diet (Institute of Medicine, 2002). Even so, median intakes were below the AI for fibre for all age/sex groups in B.C. In addition, the distributions of fibre intakes for B.C. males and for females by age are shown in Tables 6.5 and 6.6, respectively. The data indicate that dietary fibre is a priority nutrient for the public health agenda.

Table 6.4 Dietary fibre intakes by sex and age (expressed as g/d)

Sex	**Age**	**n**	**Mean ±**		**Percentiles**		**AI[2]**
	(years)		**SEM[1]**	**25th**	**50th**	**75th**	
Male	19-30	142	21 ± 1	14	18	23	38
	31-50	205	20 ± 1	14	17	23	38
	51-70	249	20 ± 1	13	18	23	30
	71+	271	21 ± 2	13	18	23	30
Female	19-30	176	16 ± 1	11	13	17	25
	31-50	266	15 ± 1	10	13	18	25
	51-70	282	17 ± 1	12	15	19	21
	71+	230	18 ± 1	12	16	19	21

[1] SEM= Standard Error of the Mean.

[2] AI=Adequate Intake.

Source: BBCA E451311-011BV S. Hayward, August 2002.

Table 6.5 Distribution of fibre intakes for males by age (expressed as a percentage of the population)[1]

Fibre (g)		**Males**		
	19-30 yr	**31-50 yr**	**51-70 yr**	**71+ yr**
< 10	3	4	7	7
≥ 10 to < 15	27	26	28	24
≥ 15 to < 20	30	35	28	29
≥ 20 to < 25	23	20	23	22
≥ 25 to < 30	6	9	5	7
≥ 30 to < 38	9	3	7	8
≥ 38	1	3	2	3

[1] Adequate Intake (AI) for males 19-50 years of age is 38 g/d and for males 51 years of age and older the AI is 30 g/d. The shaded areas represent the proportion of the population meeting this recommendation.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

Table 6.6 Distribution of fibre intakes for females by age (expressed as a percentage of the population)[1]

Fibre (g)	**Females**			
	19-30 yr	**31-50 yr**	**51-70 yr**	**71+ yr**
< 10	18	22	17	15
≥ 10 to < 15	45	36	33	25
≥ 15 to < 20	25	26	28	38
≥ 20 to < 25	11	12	12	13
≥ 25 to < 30	0	2	5	6
≥ 30	0	2	4	3

[1] Adequate Intake (AI) for females 19-50 years of age is 25 g/d and for females 51 years of age and older the AI is 21 g/d. The shaded areas represent the proportion of the population metting this recommendation.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

6.2.4 Dietary Fat

Dietary fats have received much attention in public health programming in recent years, particularly due to their role in the development or prevention of heart disease. Tables 6.7 to 6.12 provide intake data for total fat and the various types of fat.

The median total fat (Table 6.7) and monounsaturated fat (Table 6.9) intakes are similar to what has been reported in the U.S. for both men and women (Appendix R). However, the median saturated fat intakes in B.C. are slightly higher (Table 6.8). According to the new guidelines, a recommended range (AMDR) for saturated fat is not possible since they are not deemed essential and there is no evidence suggesting that they play a role in chronic disease prevention (Institute of Medicine, 2002). It is recommended to consume as little as possible saturated fat without compromising adequate nutrition provided by the foods that contain these fats. Since almost half of the B.C. population are consuming 10% or more of their calories as saturated fats (Table 6.2b), it appears that intakes are not consistent with this guideline and that saturated fats remain a public health issue for the province.

Adequate Intakes (AI) have been established for the two essential polyunsaturated fatty acids, α-linolenic acid and linoleic acid and are based on median intakes in the U.S. From the results shown in Table 6.11, it is apparent that the median intakes of the B.C. population met the AI of 1.6 g/d for males and 1.1 g/d for females for α-linolenic acid. However, the median linoleic acid intakes were well below the AI of 17 g/d for males and 12 g/d for females aged 19-50 years and 14 g/d and 11 g/d for older males and females, respectively. As well, 76% of the population was consuming less than the recommended AMDR for this fatty acid. The health implication of this result is unclear. Without biochemical and clinical data for the population, it is difficult to interpret this finding.

Table 6.7 Fat intakes by sex and age (expresses as g/d)[1]

Sex	Age (years)	n	Mean ± SEM[2]	Percentiles		
				25th	50th	75th
Male	19-30	142	100 ± 5	70	97	120
	31-50	205	96 ± 4	71	89	113
	51-70	249	84 ± 3	62	82	99
	71+	271	73 ± 3	51	64	85
Female	19-30	176	69 ± 4	51	63	80
	31-50	266	69 ± 3	50	63	79
	51-70	282	60 ± 2	46	55	64
	71+	230	51 ± 2	39	48	59

[1] There is no Dietary Reference Intake set for dietary fat.

[2] SEM= Standard Error of the Mean.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

Table 6.8 Saturated fat intakes by sex and age (expressed as g/d)[1]

Sex	Age (years)	n	Mean ± SEM[2]	Percentiles		
				25th	50th	75th
Male	19-30	142	33 ± 2	21	30	42
	31-50	205	31 ± 2	23	28	37
	51-70	249	27 ± 1	18	25	32
	71+	271	24 ± 1	15	20	28
Female	19-30	176	23 ± 2	13	19	25
	31-50	266	23 ± 1	14	20	26
	51-70	282	20 ± 1	14	18	23
	71+	230	17 ± 1	11	15	20

[1] There is no Dietary Reference Intake set for saturated fat.

[2] SEM= Standard Error of the Mean.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

Table 6.9 Monounsaturated fat intakes by sex and age (expressed as g/d)[1]

Sex	Age (years)	n	Mean ± SEM[2]	Percentiles 25th	50th	75th
Male	19-30	142	41 ± 2	25	39	50
	31-50	205	39 ± 2	29	36	43
	51-70	249	33 ± 1	24	32	39
	71+	271	29 ± 2	19	25	33
Female	19-30	176	27 ± 2	20	25	30
	31-50	266	27 ± 1	20	24	30
	51-70	282	24 ± 1	18	22	26
	71+	230	20 ± 1	14	18	22

[1] There is no Dietary Reference Intake set for monounsaturated fat.

[2] SEM= Standard Error of the Mean.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

Table 6.10 Polyunsaturated fat intakes by sex and age (expressed as g/d)[1]

Sex	Age (years)	n	Mean ± SEM[2]	Percentiles 25th	50th	75th
Male	19-30	142	17 ± 1	11	16	20
	31-50	205	17 ± 1	12	15	20
	51-70	249	15 ± 1	10	14	18
	71+	271	12 ± 1	8	11	14
Female	19-30	176	11 ± 1	9	10	13
	31-50	266	12 ± 1	8	10	13
	51-70	282	10 ± 1	7	9	11
	71+	230	9 ± 1	6	7	10

[1] There is no Dietary Reference Intake set for total polyunsaturated fat.

[2] SEM= Standard Error of the Mean.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

Table 6.11 α-Linolenic acid intakes by sex and age (expressed as g/d)[1]

Sex	Age	n	Mean ±		Percentiles	
	(years)		SEM[2]	25th	50th	75th
Male	19-30	142	2.4 ± 0.2	1.3	1.8	2.7
	31-50	205	2.3 ± 0.2	1.4	1.9	2.6
	51-70	249	2.7 ± 0.4	1.2	1.8	2.6
	71+	271	1.9 ± 0.2	1.1	1.4	2.2
Female	19-30	176	1.6 ± 0.1	1.0	1.3	1.6
	31-50	266	1.8 ± 0.1	1.1	1.3	1.7
	51-70	282	2.0 ± 0.2	1.0	1.3	1.6
	71+	230	1.5 ± 0.2	0.9	1.1	1.4

[1] Adequate Inake (AI) for α-linolenic acid is 1.6 g/day for males and 1.1 g/day for females.

[2] SEM= Standard Error of the Mean.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

Table 6.12 Linoleic acid intakes by sex and age (expressed as g/d)[1]

Sex	Age	n	Mean ±		Percentiles	
	(years)		SEM[2]	25th	50th	75th
Male	19-30	142	13.3 ± 0.8	9.1	12.0	15.0
	31-50	205	14.2 ± 0.7	9.3	12.0	16.0
	51-70	249	13.2 ± 0.8	7.7	11.0	15.0
	71+	271	10.0 ± 0.5	6.6	8.3	12.0
Female	19-30	176	9.2 ± 0.6	6.4	7.9	9.7
	31-50	266	9.5 ± 0.5	6.3	8.1	9.9
	51-70	282	8.6 ± 0.5	6.1	7.3	8.7
	71+	230	6.5 ± 0.4	4.6	5.5	7.1

[1] Adequate Inake (AI) for linoleic acid is 17 g/day for males and 12 g/day for females aged 19-50 years, and 14 g/d and 11 g/d for older males and females, respectively.

[2] SEM= Standard Error of the Mean.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

6.2.5 Cholesterol

As in the case of saturated fats, there is no DRI established for cholesterol. However, because high cholesterol intakes are associated with high blood lipid levels and a risk for heart disease, the DRI expert panel recommended keeping consumption as low as possible while maintaining a nutritionally adequate diet (Institute of Medicine, 2002).

The median intakes for dietary cholesterol, as shown in Table 6.13, ranged from 161 mg for older females to almost 300 mg in the youngest male age group. These values are less than those found in the U.S. population (Appendix R). According to Table 6.14, the majority of the population (three-quarters) consumed less than 300 mg of cholesterol per day, suggesting that many British Columbians have reduced their cholesterol intakes to what had been recommended previously (i.e., <300 mg/d, Health and Welfare Canada, 1990).

Table 6.13 Cholesterol intakes by sex and age (expressed as mg/d)[1]

Sex	Age (years)	n	Mean ± SEM[2]	Percentiles		
				25th	50th	75th
Male	19-30	142	383 ± 29	209	294	425
	31-50	205	344 ± 22	196	258	351
	51-70	249	326 ± 23	177	247	374
	71+	271	316 ± 24	158	227	351
Female	19-30	176	243 ± 25	115	166	258
	31-50	266	252 ± 17	139	195	254
	51-70	282	224 ± 13	141	175	213
	71+	230	203 ± 13	131	161	193

[1] There is no Dietary Reference Intake for dietary cholesterol.

[2] SEM = Standard Error of the Mean.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

Table 6.14 Distribution of cholesterol intake by sex and age (expressed as a percentage of the population)[1]

Cholesterol (mg/d)	Total	Males				Females			
		19-30 yr	31-50 yr	51-70 yr	71+ yr	19-30 yr	31-50 yr	51-70 yr	71+ yr
<200	45	22	27	37	38	63	53	64	78
≥200 to <300	29	29	36	28	31	21	32	26	20
≥300	26	49	37	34	31	16	16	10	2

[1] There is no Dietary Reference Intake set for dietary cholesterol.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

6.2.6 Protein

As presented previously in Table 6.2, 92% of the B.C. population was consuming 10% or more of their calories from protein, well within the acceptable range and similar to what has been reported in the U.S. (Institute of Medicine, 2002). However, there was still about 8% of the population below the EAR (Table 6.15), which is based on the lowest continuing intake of dietary protein that is sufficient to achieve body nitrogen equilibrium (zero balance) (Institute of Medicine, 2002). At this time, the health implications of having a small proportion of the population not meeting the EAR for protein are unknown and need to be considered for future research.

Table 6.15 Protein intakes by sex and age (expressed as g/kg/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles 25th	50th	75th	EAR[2]	%<EAR
Male	19-30	142	1.50 ± 0.04	1.13	1.44	1.76	0.66	4
	31-50	205	1.19 ± 0.02	0.94	1.17	1.37	0.66	4
	51-70	249	1.17 ± 0.04	0.81	1.09	1.29	0.66	9
	71+	271	0.95 ± 0.03	0.73	0.94	1.14	0.66	13
Female	19-30	176	1.04 ± 0.02	0.82	0.96	1.28	0.66	10
	31-50	266	1.05 ± 0.02	0.85	1.04	1.19	0.66	9
	51-70	282	1.00 ± 0.02	0.82	0.96	1.17	0.66	10
	71+	230	0.96 ± 0.03	0.78	0.94	1.08	0.66	8

[1] SEM = Standard Error of the Mean.

[2] EAR = Estimated Average Requirement.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

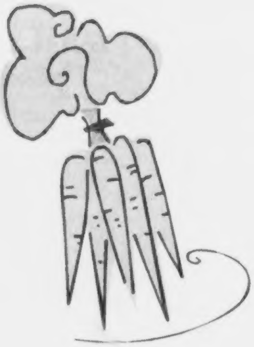
6.3 Vitamins

6.3.1 Folate

Folate functions as a co-enzyme in single carbon transfers in the metabolism of nucleic and amino acids (Institute of Medicine, 1998). The monitoring of folate status for the B.C. population is important since there is a large body of research concluding that low blood folate levels are associated with elevated serum homocysteine levels, a risk factor for cardiovascular disease and may be related to the development of some forms of cancer and depression (Tucker et al, 1996; Bailey et al, 2001; Willett and Stampfer, 2001).

Tables 6.16 and 6.17 present folate intakes from food sources (including fortified foods) and food sources plus supplements, respectively, for the B.C. adult population. Folate intake data are expressed as dietary folate equivalents (DFE). Dietary folate equivalents adjust for the lower bioavailability of naturally occurring folate in foods compared to the synthetic form (i.e., folic acid); 1 mcg DFE=0.6 mcg folic acid from fortified foods and/or supplement taken with a meal=1 mcg food folate = 0.5 mcg of a supplement taken on an empty stomach (Institute of Medicine, 1998). The median intakes for men and women from food sources alone were 496 DFE/d and 340 DFE/d, whereas the median intakes from food and supplements were 539 DFE/d and 422 DFE/d, respectively. Folate data cannot be compared to U.S. data since the U.S. data were collected prior to the fortification of the food supply with folic acid.

The EAR for folate is 320 DFE/d and was based on the amount needed to maintain red blood cell folate levels at 305 nmol/L (140ng/mL), serum folate levels at 7 nmol/L (3ng/mL) and plasma homocysteine levels at or below 14 μmol/L (Institute of Medicine, 1998). Thus, the concern with a high percentage of inadequacy in a population has more to do with the risk for heart disease and not only the risk for folate deficiency anemia. According to Tables 6.16 and 6.17, it is apparent that a large proportion of older males and adult women in all age groups were below the EAR for this vitamin. When supplement intake was included in the estimation (Table 6.17), the percentage below the EAR went down almost half for females and only slightly for the male population. But even when taking into account supplement intake, there was still an appreciable proportion of the total population not meeting the recommendation, indicating that inadequate folate intakes are a public health concern in B.C.



In addition to the relationship of inadequate folate status to heart disease, there is solid evidence relating compromised maternal folate status to the development of birth defects known as neural tube defects, with spina bifida being the most common (Hibbard and Smithells, 1965; Smithells et al, 1976; Yates et al, 1987). Studies have shown that periconceptual folic acid supplementation decreases the occurrence and recurrence rates of these birth defects (Smithells et al, 1983; Vergel et al, 1990; Laurence et al, 1981; MRC Vitamin Study Research Group, 1991; Czeizel and Dudas, 1992). For this reason, the U.S. and Canadian governments in 1998, mandated that the food supply (i.e., flours, grains and pastas) be fortified with folic acid by an amount that increases average intake by about 100 mcg/d (Food and Drug Administration, 1996; Health Canada, 1998; Daly et al, 1997). As well, a special recommendation was included in the DRI report for B vitamins (Institute of Medicine, 1998) for all women capable of becoming pregnant to consume 400 mcg of synthetic folic acid (from fortified foods and supplements) daily in order to decrease the risk of neural tube defects. Table 6.18 shows intakes of synthetic folic acid. In the B.C. population, only 21% of women in the 19-30 year age group and 18% of women in the 31-50 year age group met the special recommendation. This result is consistent to what has been reported in the literature (French et al, 2003). Mass public education campaigns conducted elsewhere have shown some increases in the number of women consuming 400 mcg of synthetic folic acid (Quinlivan and Gregory, 2003) and more dramatically, the number of women understanding the relationship between this nutrient and neural tube defects (Sayers et al, 1997). These findings warrant further investigation into potential education efforts to target women of childbearing age in B.C.

One concern for fortifying the food supply with folic acid was the possibility that certain subgroups of the population, such as the elderly, would be consuming too much folic acid and thus lead to a potential risk of masking a vitamin B12 deficiency. Thus, a Tolerable Upper Intake Level (UL) for folic acid (1000 mcg) was established and applies only to synthetic forms of the vitamin (Institute of Medicine, 1998). This UL is based on the examination of case reports of the progression of neurological effects in vitamin B12 deficient patients taking folate supplements. According to Table 6.18, about 4% of the general B.C. population and about 5% of older British Columbians were above the UL. However, because 84% of those with intakes above the UL for folic acid were also taking a vitamin B12 supplement, overconsumption of synthetic folic acid does not appear to be a major concern in the B.C. population.

Table 6.16 Folate intakes from food sources (including fortified foods) by sex and age (expressed as dietary folate equivalents[1] (DFE)/d)

Sex	Age (years)	n	Mean ± SEM[2]	Percentiles 25th	Percentiles 50th	Percentiles 75th	EAR[3]	%<EAR
Male	19-30	142	617 ± 34	453	560	647	320	2
	31-50	205	553 ± 24	406	500	572	320	5
	51-70	249	504 ± 26	335	466	593	320	20
	71+	271	382 ± 14	305	347	408	320	35
Female	19-30	176	393 ± 17	300	368	418	320	32
	31-50	266	385 ± 15	279	344	437	320	40
	51-70	282	364 ± 16	266	327	386	320	47
	71+	230	332 ± 21	237	283	346	320	67

[1] Dietary Folate Equivalents (DFE) = values that adjust for the differences in absorption of food folate and synthetic folic acid. 1 mcg of DFE = 0.6 mcg of folic acid from fortified food or as a supplement taken with a meal = 1 mcg food folate = 0.5 mcg of folic acid from a supplement taken on an empty stomach.

[2] SEM = Standard Error of the Mean

[3] EAR = Estimated Average Requirement

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

Table 6.17 Folate intakes from food sources (including fortified foods) and supplements by sex and age (expressed as dietary folate equivalents[1] (DFE)/d)

Sex	Age (years)	n	Mean ± SEM[2]	Percentiles 25th	Percentiles 50th	Percentiles 75th	EAR[3]	%<EAR
Male	19-30	142	729 ± 30	483	591	764	320	2
	31-50	205	796 ± 60	436	535	748	320	3
	51-70	249	663 ± 35	370	524	745	320	16
	71+	271	720 ± 96	317	392	749	320	27
Female	19-30	176	607 ± 29	342	419	662	320	19
	31-50	266	621 ± 27	330	427	764	320	23
	51-70	282	671 ± 39	313	429	942	320	29
	71+	230	737 ± 77	276	405	1019	320	39

[1] Dietary Folate Equivalents (DFE) = values that adjust for the differences in absorption of food folate and synthetic folic acid. 1 mcg of DFE = 0.6 mcg of folic acid from fortified food or as a supplement taken with a meal = 1 mcg food folate = 0.5 mcg of folic acid from a supplement taken on an empty stomach.

[2] SEM = Standard Error of the Mean

[3] EAR = Estimated Average Requirement

Source: BBCA E431311-011CV1 Supplement Tables - S. Hayward, August 2002.

Table 6.18 Folic acid[1] intakes from fortified foods and supplements by sex and age (expressed as mcg/d)

Sex	Age (years)	n	Mean ± SEM[2]	Percentiles			UL[3]	%>UL
				25th	50th	75th		
Male	19-30	142	264 ± 17	129	176	263	1000	3
	31-50	205	305 ± 36	112	149	227	1000	4
	51-70	249	233 ± 20	94	144	244	1000	2
	71+	271	284 ± 57	55	92	254	1000	7
Female	19-30	176	244 ± 17	96	126	294	1000	4
	31-50	266	244 ± 15	80	119	324	1000	4
	51-70	282	268 ± 22	65	96	453	1000	5
	71+	230	311 ± 46	51	86	469	1000	5

[1] Folic Acid represents the synthetic form of the vitamin

[2] SEM= Standard Error of the Mean

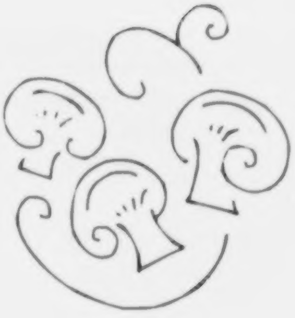
[3] UL = Tolerable Upper Intake Level

Source: BBCA E431311-011CV1 Supplement Tables - S. Hayward, August 2002

6.3.2 Niacin

Niacin, in its co-enzyme form, is involved in many biological reactions, functioning in intracellular respiration and oxidation of fuel molecules, as well as reductive biosynthesis (Institute of Medicine, 1998). The median intakes from food alone and from both food and supplements were well above what was estimated for the U.S. population according to NHANES III data (Appendix R). British Columbians' higher intakes from food are due to the fact that intakes are expressed in Niacin Equivalents, which include both preformed niacin and the contibution of tryptophan to synthesis of niacin coenzymes. In contrast, the U.S. intake date are based on preformed niacin alone.

The UL for niacin is based on the amount of the synthetic form of niacin found in supplements, fortified foods and pharmacological agents, that induces the adverse effect of flushing. In the U.S., a large percentage of the senior population was above the UL (United States Department of Agriculture, 1995). This finding was explained by the fact that many older adults consumed vitamin and mineral supplements and some received pharmacological doses for the management of serum cholesterol levels. In the BCNS, synthetic niacin was estimated using the supplement data only since it would be difficult to determine the amount contributed by fortified foods. Nonetheless, the BCNS results show that 12% of men and 21% of women have niacin levels that exceed the UL,



suggesting that over consumption of niacin may be a concern for the B.C. population and should be earmarked for future monitoring. However, it should also be noted that the adverse effect (flushing) is relatively benign and would not be anticipated to have a serious health impact.

Table 6.19 Niacin intakes from food sources by sex and age (expressed as Niacin Equivalents (NE)/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles 25th	Percentiles 50th	Percentiles 75th	EAR[2]	%<EAR
Male	19-30	142	55 ± 2	41	50	63	12	0
	31-50	205	47 ± 2	37	45	53	12	0
	51-70	249	44 ± 2	33	41	51	12	0
	71+	271	36 ± 1	30	34	40	12	0
Female	19-30	176	31 ± 1	26	29	34	11	0
	31-50	266	32 ± 1	26	30	34	11	0
	51-70	282	32 ± 1	25	30	34	11	0
	71+	230	29 ± 1	24	27	33	11	0

[1] SEM = Standard Error of the Mean.

[2] EAR = Estimated Average Requirement.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

Table 6.20 Niacin intakes from food sources and supplements by sex and age (expressed as Niacin Equivalents (NE)/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles 25th	Percentiles 50th	Percentiles 75th	EAR[2]	%<EAR	UL[3]	% > UL[4]
Male	19-30	142	61 ± 2	44	57	72	12	0	35	10
	31-50	205	55 ± 1	38	50	64	12	0	35	12
	51-70	249	60 ± 7	36	48	61	12	0	35	12
	71+	271	94 ± 28	33	39	58	12	0	35	19
Female	19-30	176	48 ± 1	28	35	48	11	0	35	12
	31-50	266	50 ± 2	29	36	59	11	0	35	20
	51-70	282	79 ± 21	29	37	63	11	0	35	27
	71+	230	51 ± 3	28	38	68	11	0	35	37

[1] SEM = Standard Error of the Mean.

[2] EAR = Estimated Average Requirement.

[3] UL = Tolerable Upper Intake Level, based on the consumption of synthetic niacin in fortified foods, supplements and pharmacologic agents.

[4] Reflects only intake from supplements.

Source: BBCA E431311-011CV1 Supplement Tables - S. Hayward, August 2002.

6.3.3 Pantothenic Acid

Pantothenic acid is a vital co-enzyme that is required in reactions that generate energy from food (Institute of Medicine, 1998). The values for pantothenic acid intakes from food sources alone are shown in Table 6.21. According to the median intakes, males met the AI (5 mg/d) for pantothenic acid but females did not. The health implications of this result for the B.C. population are unclear, as intakes below the AI may be adequate. Further, it is known that true pantothenic acid deficiency is rare as this vitamin is found in almost all plant and animal foods (Institute of Medicine, 1998). When supplement intake is included (Table 6.22), women's median intakes for all age groups were approaching the AI.

Table 6.21 Pantothenic acid intakes from food sources by sex and age (expressed as mg/d)

Sex	Age (years)	n	Mean ± SEM[2]	Percentiles			AI[1]
				25th	50th	75th	
Male	19-30	142	7.2 ± 0.4	5.3	6.7	7.7	5
	31-50	205	6.0 ± 0.2	4.9	5.6	6.5	5
	51-70	249	5.6 ± 0.2	4.4	5.3	6.3	5
	71+	271	5.4 ± 0.2	3.9	4.9	5.9	5
Female	19-30	176	4.5 ± 0.2	3.4	4.0	4.8	5
	31-50	266	4.3 ± 0.2	3.2	4.0	4.6	5
	51-70	282	4.3 ± 0.1	3.4	4.2	4.7	5
	71+	230	4.2 ± 0.2	3.4	3.9	4.5	5

[1] AI = Adequate Intake.

[2] SEM = Standard Error of the Mean.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

Table 6.22 Pantothenic acid intakes from food sources and supplements by sex and age (expressed as mg/d)

Sex	Age (years)	n	Mean ± SEM[2]	Percentiles 25th	50th	75th	AI[1]
Male	19-30	142	9.8 ± 0.5	5.5	7.1	11.5	5
	31-50	205	10.4 ± 0.7	5.2	5.9	8.0	5
	51-70	249	11.6 ± 2.4	4.6	6.0	9.5	5
	71+	271	9.3 ± 2.6	4.2	5.4	8.4	5
Female	19-30	176	8.8 ± 0.7	3.5	4.9	10.6	5
	31-50	266	14.8 ± 1.7	3.5	5.0	12.7	5
	51-70	282	16.6 ± 2.1	3.9	5.0	14.3	5
	71+	230	10.4 ± 1.5	3.8	4.6	13.7	5

[1] AI = Adequate Intake.

[2] SEM = Standard Error of the Mean.

Source: BBCA E431311-011CV1 Supplement Tables- S. Hayward, August 2002.

6.3.4 Riboflavin

Riboflavin functions as a co-enzyme in many metabolic pathways and in energy production (Institute of Medicine, 1998). The median intakes from food sources alone for the B.C. population (Table 6.23) were very similar to what has been reported for the U.S. in NHANES III but the total median intakes including supplements (Table 6.24) were higher in B.C. (Appendix R). This difference could be explained by the fact that British Columbians consume more supplements than the adult population in the U.S. (Refer to Section 5.5.) and the major supplements used are multivitamin types.[f] Tables 6.23 and 6.24 show that riboflavin intakes were generally above the EAR, suggesting that British Columbians have adequate intakes of riboflavin.

Table 6.23 Riboflavin intakes from food sources by sex and age (expressed as mg/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles 25th	50th	75th	EAR[2]	%<EAR
Male	19-30	142	2.6 ± 0.1	1.8	2.3	3.1	1.1	3
	31-50	205	2.3 ± 0.1	1.8	2.1	2.5	1.1	3
	51-70	249	2.2 ± 0.1	1.6	2.0	2.4	1.1	3
	71+	271	2.0 ± 0.1	1.5	1.9	2.2	1.1	5
Female	19-30	176	1.8 ± 0.1	1.4	1.6	2.0	0.9	2
	31-50	266	1.6 ± 0.1	1.3	1.5	1.8	0.9	8
	51-70	282	1.6 ± 0.1	1.3	1.5	1.8	0.9	4
	71+	230	1.6 ± 0.1	1.2	1.4	1.8	0.9	3

[1] SEM = Standard Error of the Mean.

[2] EAR = Estimated Average Requirement.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

Table 6.24 Riboflavin intakes from food sources and supplements by sex and age (expressed as mg/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles 25th	50th	75th	EAR[2]	%<EAR
Male	19-30	142	4.6 ± 0.5	1.9	2.8	4.2	1.1	2
	31-50	205	5.9 ± 0.6	1.9	2.4	3.4	1.1	3
	51-70	249	4.6 ± 0.6	1.7	2.2	3.6	1.1	3
	71+	271	5.0 ± 1.3	1.6	2.2	3.4	1.1	4
Female	19-30	176	5.8 ± 0.6	1.5	2.2	5.1	0.9	2
	31-50	266	10.3 ± 1.3	1.4	2.0	5.3	0.9	6
	51-70	282	10.0 ± 1.7	1.5	2.0	5.2	0.9	1
	71+	230	8.4 ± 1.9	1.5	2.6	4.9	0.9	1

[1] SEM = Standard Error of the Mean.

[2] EAR = Estimated Average Requirement.

Source: BBCA E431311-011CV1 Supplement Tables - S. Hayward, August 2002.

6.3.5 Thiamin

Thiamin functions as a co-enzyme in carbohydrate and branched-chain amino acid metabolism (Institute of Medicine, 1998). Thiamin intakes from food sources and food sources plus supplements are presented in Tables 6.25 and 6.26, respectively. Median thiamin intakes from food sources were higher for British Columbian men but similar for women when compared to U.S. data (Appendix R). However, the B.C. adult population had higher total median intakes when supplements were included in the estimation than adults in the U.S. (Appendix R). Again, this difference could be explained by the higher consumption of nutritional supplements in B.C. than the U.S. (Refer to Section 5.5.) As with riboflavin and niacin, thiamin intakes (Tables 6.25 and 6.26) were generally above the EAR. Thus, British Columbians have adequate intakes of thiamin.

Table 6.25 Thiamin intakes from food sources by sex and age (expressed as mg/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles 25th	50th	75th	EAR[2]	%<EAR
Male	19-30	142	2.4 ± 0.1	1.6	2.2	2.8	1.0	3
	31-50	205	2.1 ± 0.1	1.6	1.9	2.3	1.0	<1
	51-70	249	2.1 ± 0.1	1.4	1.9	2.4	1.0	5
	71+	271	1.7 ± 0.1	1.4	1.6	1.8	1.0	3
Female	19-30	176	1.6 ± 0.1	1.1	1.3	1.7	0.9	7
	31-50	266	1.4 ± 0.1	1.1	1.3	1.6	0.9	14
	51-70	282	1.5 ± 0.1	1.1	1.3	1.7	0.9	14
	71+	230	1.4 ± 0.1	1.1	1.3	1.5	0.9	5

[1] SEM= Standard Error of the Mean.

[2] EAR = Estimated Average Requirement.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

Table 6.26 Thiamin intakes from food sources and supplements by sex and age (expressed as mg/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles 25th	50th	75th	EAR[2]	%<EAR
Male	19-30	142	4.1 ± 0.4	1.8	2.4	3.8	1.0	2
	31-50	205	5.7 ± 0.6	1.7	2.1	3.2	1.0	<1
	51-70	249	5.2 ± 0.9	1.5	2.1	3.3	1.0	4
	71+	271	4.7 ± 1.4	1.5	1.8	2.8	1.0	1
Female	19-30	176	5.5 ± 0.6	1.2	1.9	3.8	0.9	5
	31-50	266	10.4 ± 1.3	1.2	1.7	4.1	0.9	11
	51-70	282	11.2 ± 1.8	1.2	1.9	4.4	0.9	7
	71+	230	8.3 ± 2.0	1.2	2.2	3.7	0.9	1

[1] SEM= Standard Error of the Mean.

[2] EAR = Estimated Average Requirement.

Source: BBCA E431311-011CV1 Supplement Tables - S. Hayward, August 2002.

6.3.6 Vitamin B6

Vitamin B6 functions as a co-enzyme for more than 100 enzymes involved in the metabolism of amino acids (Institute of Medicine, 1998). Low serum levels of B6 have been associated with high blood homocysteine levels, a known risk factor for heart disease (Institute of Medicine, 1998). According to Tables 6.27 and 6.28, the median intakes for British Columbian men and women from food sources alone and from food plus supplements were 2.1 and 1.4 mg/d and 2.3 and 1.9 mg/d, respectively. U.S. data from NHANES III showed slightly lower median dietary intakes for vitamin B6 (Appendix R).

In the B.C. population, between 19%-20% of males over 50 years of age and 16%-36% of all females had vitamin B6 intakes below the EAR (Table 6.27). As well, appreciable percentages of the older male population and adult females of all ages in the U.S. were below the EAR (Institute of Medicine, 1998). When supplements were included in estimating intake (Table 6.28), the proportion of older females below the EAR was reduced by almost half but only slightly for older males or younger females. The health implications of inadequate vitamin B6 intakes remain unclear. However, the vitamin does remain a potential concern for British Columbians.

Table 6.27 Vitamin B6 intakes from food sources by sex and age (expressed as mg/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles			EAR[2]	%<EAR	UL[3]	% > UL
				25th	50th	75th				
Male	19-30	142	2.6 ± 0.2	2.0	2.4	2.9	1.1	2	100	0
	31-50	205	2.2 ± 0.1	1.7	2.1	2.3	1.1	0	100	0
	51-70	249	2.0 ± 0.1	1.5	2.0	2.3	1.4	21	100	0
	71+	271	1.9 ± 0.1	1.5	1.8	2.1	1.4	19	100	0
Female	19-30	176	1.5 ± 0.1	1.2	1.4	1.6	1.1	16	100	0
	31-50	266	1.5 ± 0.1	1.2	1.4	1.6	1.1	19	100	0
	51-70	282	1.7 ± 0.1	1.3	1.5	1.9	1.3	29	100	0
	71+	230	1.5 ± 0.1	1.2	1.5	1.7	1.3	36	100	0

[1] SEM= Standard Error of the Mean.

[2] EAR = Estimated Average Requirement.

[3] UL=Tolerable Upper Intake Level.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

Table 6.28 Vitamin B6 intakes from food sources and supplements by sex and age (expressed as mg/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles 25th	50th	75th	EAR[2]	%<EAR	UL[3]	% > UL
Male	19-30	142	4.5 ± 0.4	2.0	2.8	3.9	1.1	2	100	0
	31-50	205	5.9 ± 0.7	1.8	2.2	3.3	1.1	0	100	<1
	51-70	249	6.5 ± 1.1	1.6	2.2	3.6	1.4	19	100	2
	71+	271	6.7 ± 1.9	1.6	2.0	3.9	1.4	15	100	2
Female	19-30	176	6.1 ± 0.7	1.3	1.7	4.8	1.1	13	100	0
	31-50	266	10.5 ± 1.4	1.3	1.7	5.3	1.1	15	100	3
	51-70	282	11.8 ± 2.0	1.5	2.1	6.8	1.3	16	100	5
	71+	230	20.9 ± 8.5	1.5	2.1	9.2	1.3	20	100	5

[1] SEM= Standard Error of the Mean.

[2] EAR = Estimated Average Requirement.

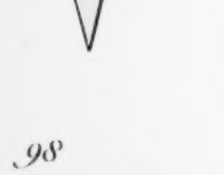
[3] UL =Tolerable Upper Intake Level.

Source: BBCA E431311-011CV1 Supplement Tables - S. Hayward, August 2002.

6.3.7 Vitamin B12

A vitamin B12 intake level meeting the EAR of 2 mcg/d has been deemed necessary for the maintenance of hematological status (Institute of Medicine, 1998). Vitamin B12 intakes for the B.C. adult population are shown in Tables 6.29 and 6.30. In the U.S., the median intakes for both men and women were much higher than the B.C. data (Appendix R). Unlike Canada, the U.S. fortifies a variety of grains and cereals with vitamin B12, which may account for their higher intakes. In Table 6.30, it appears that the mean intakes are much higher than the median values for all ages and both sexes. This finding is due to the consumption of large amounts of vitamin B12 supplements consumed by a few participants.

As noted in Table 6.29, 7%-13% of males and 18%-38% of females were below the EAR for vitamin B12. The proportion of females below the EAR was reduced substantially when supplements were consumed but there was still 10%-21% of this population inadequate (Table 6.30). Supplements had little effect on the intakes of the male population.



Monitoring B12 intakes and status of individuals over 50 years of age is important because 10%-30% of this population may have decreased absorption of this vitamin resulting in a deficiency. For this reason, the expert DRI panel recommended that older individuals consume B12 fortified foods and/or a supplement (Institute of Medicine, 1998). Since vitamin B12 supplements and/or fortified foods are the recommended forms to increase B12 intake for adults over 50 years of age, estimated intakes from supplements alone were generated for this age group (data not shown). Fortified foods were not included in the estimate since very few foods are fortified with B12 in Canada. About 72% of men and 58% of women over 50 years of age were below the EAR from supplements alone. The findings indicate that vitamin B12 is an important nutrient to monitor.

Table 6.29 Vitamin B12 intakes from food sources by sex and age (expressed as mcg/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles 25th	Percentiles 50th	Percentiles 75th	EAR[2]	%<EAR
Male	19-30	142	5.9 ± 0.6	3.0	4.3	6.2	2	7
	31-50	205	6.4 ± 0.7	3.0	3.9	5.2	2	10
	51-70	249	6.6 ± 1.1	2.6	3.4	4.6	2	8
	71+	271	5.9 ± 0.7	2.4	3.3	4.6	2	13
Female	19-30	176	4.1 ± 1.0	1.8	2.3	3.2	2	38
	31-50	266	4.1 ± 0.6	2.0	2.5	3.2	2	25
	51-70	282	3.9 ± 0.5	2.1	2.6	3.2	2	20
	71+	230	4.1 ± 0.5	2.1	2.6	3.3	2	18

[1] SEM = Standard Error of the Mean.

[2] EAR = Estimated Average Requirement.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

Table 6.30 Vitamin B12 intakes from food sources and supplements by sex and age (expressed as mcg/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles 25th	Percentiles 50th	Percentiles 75th	EAR[2]	%<EAR
Male	19-30	142	9.9 ± 1.1	3.5	5.4	9.1	2	5
	31-50	205	33.2 ±13.8	3.3	4.9	9.2	2	9
	51-70	249	12.7 ± 2.5	2.8	4.3	11.0	2	7
	71+	271	37.4 ± 15.2	2.5	4.2	16.5	2	12
Female	19-30	176	11.0 ± 1.4	2.0	3.7	11.5	2	21
	31-50	266	26.5 ± 13.0	2.2	3.5	13.0	2	16
	51-70	282	109.5 ± 60	2.3	3.9	22.5	2	13
	71+	230	37.6 ± 15.5	2.5	4.7	27.1	2	10

[1] SEM= Standard Error of the Mean.

[2] EAR = Estimated Average Requirement.

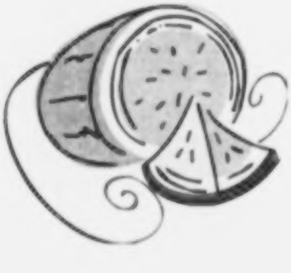
Source: BBCA E431311-011CV1 Supplement Tables - S. Hayward, August 2002.

6.3.8 Vitamin C

Vitamin C functions as an antioxidant providing reducing equivalents for many biochemical reactions (Institute of Medicine, 2000). Studies suggest that anti-oxidants such as vitamin C play a role in lowering the risk for cardiovascular disease, some cancers and conditions such as macular degeneration (Rose et al, 1998). Vitamin C intakes from food sources alone and from food sources and supplements for B.C. are shown in Tables 6.31 and 6.32, respectively. The median intakes from food sources alone for B.C. (Table 6.31) were generally lower than those reported for the U.S. adult population in NHANES III (Appendix R). However, British Columbian males 71 years and older and all female age groups had higher median vitamin C intakes when supplements were included in the total intakes (Table 6.32 and Appendix R). This result may be due to higher nutritional supplement consumption seen in adult British Columbians, especially in the older age groups (refer to section 5.5). As noted in section 5.5, vitamin C was one of the major nutritional supplements that adults in B.C. used.

The EAR for vitamin C was established as the intake that would provide anti-oxidant protection and is set at 75 mg/d for males and 60 mg/d for females. Almost a third of the B.C. population is below the EAR from food sources alone (Table 6.31). This proportion decreases to about 21% once supplements are included in the estimate as seen in Table 6.32. Nonetheless, inadequate intakes of this vitamin are a public health concern for British Columbians because of its anti-oxidant effects in lowering the risk of chronic diseases.

It is important to note that smoking cigarettes can compromise the anti-oxidant property of vitamin C, resulting in a higher requirement of the vitamin for individuals who smoke. Thus, the expert DRI panel (Institute of Medicine, 2000) recommended that smokers consume 35 mg more per day than non-smokers. The BCNS researchers were interested in examining if smokers in B.C. had a higher percentage of inadequate intakes of this vitamin than non-smokers. Since there were too few smokers to determine adjusted distributions accurately, adequacy of vitamin C intakes could not be estimated directly. Instead, mean intakes for smokers versus non-smokers by age and sex were determined. The mean intakes including food and supplements were 344 ± 51 mg/d and 419 ± 16 mg/d for smokers and non-smokers, respectively. No difference in mean intakes (p=.162) was found between the two groups, suggesting that a higher proportion of smokers, who have an increased requirement for vitamin C, have inadequate intakes of this vitamin compared to non-smokers in B.C.



The UL for vitamin C (2000 mg/d) was derived from the amount of the vitamin consumed from food and supplements that resulted in the adverse effect of diarrhea. Over-consumption of vitamin C is not an issue in the B.C. population despite being a frequently consumed supplement (Tables 6.31 and 6.32).

Table 6.31 Vitamin C intakes from food sources by sex and age (expressed as mg/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles 25th	50th	75th	EAR[2]	%<EAR	UL[3]	% > UL
Male	19-30	142	145 ± 20	71	92	132	75	31	2000	0
	31-50	205	131 ± 10	55	94	155	75	42	2000	0
	51-70	249	122 ± 9	60	98	137	75	34	2000	0
	71+	271	116 ± 8	74	96	123	75	27	2000	0
Female	19-30	176	105 ± 9	52	74	110	60	33	2000	0
	31-50	266	110 ± 11	53	76	118	60	32	2000	0
	51-70	282	121 ± 6	68	101	130	60	20	2000	0
	71+	230	100 ± 6	53	85	122	60	26	2000	0

[1] SEM= Standard Error of the Mean.

[2] EAR = Estimated Average Requirement.

[3] UL = Tolerable Upper Intake Level.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

Table 6.32 Vitamin C intakes from food sources and supplements by sex and age (expressed as mg/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles 25th	50th	75th	EAR[2]	%<EAR	UL[3]	% > UL
Male	19-30	142	214 ± 22	75	119	208	75	25	2000	2
	31-50	205	272 ± 19	61	120	276	75	34	2000	<1
	51-70	249	255 ± 26	72	118	229	75	26	2000	2
	71+	271	350 ± 58	83	136	361	75	16	2000	1
Female	19-30	176	207 ± 18	63	126	219	60	23	2000	1
	31-50	266	352 ± 33	67	129	370	60	21	2000	3
	51-70	282	356 ± 33	98	185	427	60	11	2000	2
	71+	230	361 ± 70	88	165	409	60	13	2000	1

[1] SEM= Standard Error of the Mean.

[2] EAR = Estimated Average Requirement.

[3] UL =Tolerable Upper Intake Level.

Source: BBCA E431311-011CV1 Supplement Tables- S. Hayward, August 2002.

6.4 Minerals

6.4.1 Calcium

The main function of calcium is to provide structural support for a healthy skeletal system. Calcium is also required for muscle contractions, vaso-dilation and constriction, nerve transmission and glandular secretions (Institute of Medicine, 1997). Adequate intakes of calcium and vitamin D throughout life along with regular physical activity are needed to build and maintain strong bones and prevent osteoporosis (Osteoporosis Society of Canada, 1993). Peak bone mass is achieved between the ages of 19 and 30 years, after which time gradual bone demineralization occurs (Institute of Medicine, 1997). Thus, the current AIs for calcium are based on calcium retention in bone for all age groups.

Calcium intakes and their distribution in the B.C. population are presented in Tables 6.33 to 6.36. Except for men aged 19-30 years, the median calcium intakes in B.C. were well below the AI (Tables 6.33 and 6.35). Median intakes for the adult B.C. population appear to be slightly higher than the intakes reported in the U.S. from food sources alone (Appendix R) for reasons unknown. Usual intake data from the U.S. were not available from the combination of food plus supplements for calcium and, thus, no comparisons could be made.

When looking at the distribution of calcium intakes from food sources alone (Table 6.34), about 45% of men from 19-50 years of age were above the AI and for those 51 and over only about 10% were above the AI. For women aged 19-50 years, about 19% were over the AI and for those over 50 years of age, the proportion dropped to 4%-8%. Supplements contributed greatly to calcium intakes (Table 6.36) for men over 70 years of age and women over 30.

Few adults were above the UL for calcium from food sources and when supplements were included in the estimation (Tables 6.33 and 6.35). However, low calcium intakes are a problem for both sexes and worsen with age. Given the high burden of morbidity and mortality attributable to osteoporosis and the possibility that calcium may also decrease the risk of other conditions such as hypertension and colon cancer, increasing calcium intakes is another priority for the public health agenda.

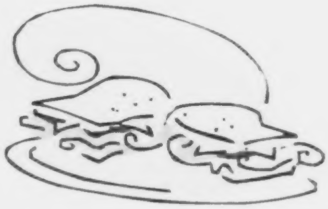


Table 6.33 Calcium intakes from food sources by sex and age (expressed as mg/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles 25th	50th	75th	AI[2]	UL[3]	% > UL
Male	19-30	142	1193 ± 74	724	1030	1377	1000	2500	1
	31-50	205	980 ± 48	652	883	1143	1000	2500	0
	51-70	249	858 ± 35	618	771	1062	1200	2500	0
	71+	271	796 ± 35	567	726	951	1200	2500	0
Female	19-30	176	876 ± 48	589	758	1007	1000	2500	0
	31-50	266	750 ± 31	526	679	876	1000	2500	0
	51-70	282	726 ± 32	489	666	863	1200	2500	0
	71+	230	742 ± 37	516	662	843	1200	2500	0

[1] SEM= Standard Error of the Mean.

[2] AI= Adequate Intake.

[3] UL=Tolerable Upper Intake Level.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

Table 6.34 Distribution of calcium intakes from food sources by sex and age (expressed as a percentage of the population)[1]

Calcium (mg)	Males 19-30 yr	31-50 yr	51-70 yr	71+ yr	Females 19-30 yr	31-50 yr	51-70 yr	71+ yr
<400	2	4	6	8	8	13	12	12
≥400 to <600	9	15	16	21	18	20	32	25
≥600 to <800	20	22	30	34	30	36	25	34
≥800 to <1000	17	22	18	18	18	18	18	14
≥1000 to <1200	12	13	18	9	15	10	9	6
≥1200	41	24	12	9	11	3	4	8

[1] Adequate Intake (AI) for males and females from 19-50 years of age is 1000 mg. AI for males and females over 50 years of age is 1200 mg. The shaded areas represent the proportion of the population meeting the recommendation.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

Table 6.35 Calcium intakes from food sources and supplements by sex and age (expressed as mg/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles 25th	50th	75th	AI[2]	UL[3]	% > UL
Male	19-30	142	1179 ± 34	735	1049	1446	1000	2500	1
	31-50	205	994 ± 21	721	906	1244	1000	2500	0
	51-70	249	917 ± 25	661	885	1123	1200	2500	0
	71+	271	915 ± 42	626	847	1159	1200	2500	0
Female	19-30	176	889 ± 27	619	852	1067	1000	2500	<1
	31-50	266	873 ± 20	606	827	1096	1000	2500	0
	51-70	282	1012 ± 43	593	863	1272	1200	2500	3
	71+	230	1056 ± 49	641	948	1404	1200	2500	<1

[1] SEM= Standard Error of the Mean.

[2] AI=Adequate Intake.

[3] UL=Tolerable Upper Intake Level.

Source: BBCA E431311-011CV1 Supplement Tables - S. Hayward, August 2002.

Table 6.36 Distribution of Calcium intakes from food sources and supplements by sex and age (expressed as a percentage of the population)[1]

Calcium (mg)	Males				Females			
	19-30 yr	31-50 yr	51-70 yr	71+ yr	19-30 yr	31-50 yr	51-70 yr	71+ yr
<400	2	3	6	4	7	10	6	4
≥400 to <600	6	14	11	16	14	14	19	16
≥600 to <800	21	21	24	26	21	25	20	19
≥800 to <1000	18	21	21	22	24	20	15	17
≥1000 to <1200	11	13	20	10	17	12	12	10
≥1200	43	29	19	22	16	19	28	34

[1] Adequate intake (AI) for males and females from 19-50 years of age is 1000 mg. AI for males and females over 50 years of age is 1200 mg. The shaded areas represent the proportion of the population meeting the recommendations.

Source: BBCA E431311-011CV1 Supplement Tables - S. Hayward, August 2002.

6.4.2 Iron

As a component of many proteins, iron functions mainly to deliver oxygen to body tissues for metabolic reactions. Inadequate iron intakes can lead to a decrease in iron stores and eventually iron deficiency anemia (Institute of Medicine, 2001).

Iron intakes from food sources and foods plus supplements are shown in Tables 6.37 and 6.38. Median iron intakes in B.C. were comparable to what was estimated for the U.S. adult population (Appendix R).

The proportion of a population that falls below the requirement for iron is determined by the full probability method as explained in Appendices M and N. As noted in both Tables 6.37 and 6.38, the only group at risk for inadequate iron intakes was females from 19-50 years of age, representing pre-menopausal women. This result is not surprising, since women are known to be at risk for iron deficiency anemia because of low dietary intakes and the loss of blood each month due to menstruation (Institute of Medicine, 2001). However, optimal iron status is critical during childbearing years, as adequate iron stores are important for healthy pregnancy and lactation. Thus, the iron status of women of childbearing age should be closely monitored.

The Tolerable Upper Intake Level (UL) for iron is set at 45 mg/d for all adults. As shown in Tables 6.37 and 6.38, excessive iron intakes were not found to be a problem in the B.C. adult population.

Table 6.37 Iron intakes from food sources by sex and age (expressed as mg/d)

Sex	Age	n	Mean ±	Percentiles			% <	UL[3]	% > UL
	(years)		SEM[1]	25th	50th	75th	Requirement[2]		
Male	19-30	142	19.7 ± 0.9	15.0	19.0	23.0	0	45	0
	31-50	205	18.0 ± 0.6	13.0	17.0	21.0	0	45	0
	51-70	249	17.3 ± 0.7	13.0	16.0	20.0	1	45	<1
	71+	271	15.0 ± 0.6	12.0	14.0	17.0	1	45	0
Female	19-30	176	13.4 ± 0.6	10.0	12.0	15.0	14	45	0
	31-50	266	12.8 ± 0.4	9.7	12.0	15.0	20	45	0
	51-70	282	12.7 ± 0.6	9.6	12.0	14.0	1	45	0
	71+	230	12.2 ± 0.5	9.5	12.0	13.0	1	45	0

SEM= Standard Error of the Mean.

Requirement estimated using the full probability model (Appendix M).

UL =Tolerable Upper Intake Level

Source: BBCA E451311-011BV1 S. Hayward, August 2002

Table 6.38 Iron intakes from food sources and supplements by sex and age (expressed as mg/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles			% < Requirement	UL[3]	% > UL
				25th	50th	75th			
Male	19-30	142	21.0 ± 0.5	15.4	18.9	24.4	0	45	1
	31-50	205	18.7 ± 0.4	14.0	17.4	22.5	0	45	<1
	51-70	249	17.8 ± 0.4	13.5	17.0	20.4	1	45	<1
	71+	271	19.6 ± 1.9	12.1	15.7	20.2	1	45	4
Female	19-30	176	16.3 ± 0.7	10.9	13.2	17.6	12	45	3
	31-50	266	17.0 ± 0.8	10.2	13.7	19.0	16	45	3
	51-70	282	13.6 ± 0.3	10.6	12.2	16.4	1	45	0
	71+	230	15.1 ± 1.1	10.7	13.5	16.6	1	45	2

[1] SEM= Standard Error of the Mean.

[2] Requirement estimated using the full probability model (Appendix N).

[3] UL=Tolerable Upper Intake Level.

Source: BBCA E431311-011CV1 Supplement Tables - S. Hayward, August 2002.

6.4.3 Magnesium

Magnesium plays a role in maintaining normal blood pressure and is a co-factor for over 300 enzyme systems. The disorders associated with magnesium deficiency are complex and usually accompanied by multiple metabolic and nutritional disturbances (Institute of Medicine, 1997).

Magnesium intakes from food sources and food sources plus supplements are provided in Tables 6.39 and 6.40, respectively. The median intakes of magnesium from food sources alone were similar to the results from NHANES III, showing low intakes of this mineral (Appendix R). Usual intake data from the U.S. were not available from the combination of food plus supplements for magnesium and, thus, no comparisons could be made.

The percentage below the EAR is very high for both sexes and all ages, with a range of 32%-62% from food alone and 26%-52% from food and supplements. It is apparent that supplement use had an impact on magnesium intakes for older males and females of all ages, but there was still an appreciable proportion of the population below the EAR even when supplements were included in the estimation (Table 6.40). The health implications of these findings are unclear and further research is needed to better understand the meaning of these results.

The UL for magnesium is based on adverse gastrointestinal effects such as diarrhea that accompanies the consumption of 350 mg or more of a synthetic form of the mineral. A small fraction of the B.C. adult population was above the UL for magnesium. But it is important to note that this estimation was based on supplement intake only and did not take into account magnesium intake from other agents such as laxatives or antacids.

Table 6.39 Magnesium intakes from food sources by sex and age (expressed as mg/d)

Sex	Age	n	Mean ±	Percentiles			EAR[2]	%<EAR
	(years)		SEM[1]	25th	50th	75th		
Male	19-30	142	410 ± 17	323	396	475	330	32
	31-50	205	404 ± 13	343	383	430	350	33
	51-70	249	374 ± 12	303	371	426	350	44
	71+	271	352 ± 16	282	331	407	350	62
Female	19-30	176	304 ± 13	246	286	323	255	37
	31-50	266	296 ± 10	234	287	324	265	43
	51-70	282	308 ± 11	237	283	343	265	40
	71+	230	296 ± 11	242	273	320	265	45

[1] SEM= Standard Error of the Mean.

[2] EAR = Estimated Average Requirement.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

Table 6.40 Magnesium intakes from food sources and supplements by sex and age (expressed as mg/d)

Sex	Age	n	Mean ±	Percentiles			EAR[2]	%<EAR	UL[3]	% > UL
	(years)		SEM[1]	25th	50th	75th				
Male	19-30	142	414 ± 9	323	410	482	330	31	350	1
	31-50	205	402 ± 6	336	384	449	350	31	350	<1
	51-70	249	391 ± 8	307	382	467	350	37	350	1
	71+	271	373 ± 14	288	340	436	350	52	350	<1
Female	19-30	176	305 ± 6	242	295	348	255	31	350	1
	31-50	266	336 ± 8	234	301	374	265	36	350	3
	51-70	282	386 ± 13	264	326	447	265	27	350	8
	71+	230	342 ± 13	260	313	392	265	26	350	3

[1] SEM= Standard Error of the Mean.

[2] EAR = Estimated Average Requirement.

[3] UL = Tolerable Upper Intake Level which is based only on the synthetic form from pharmacological agents and is equal to 350mg.

Source: BBCA E431311-011CV1 Supplement Tables - S. Hayward, August 2002.

6.4.4 Phosphorus

Phosphorus plays a role in bone health along with calcium, vitamin D, magnesium and fluoride (Institute of Medicine, 2000). Tables 6.41 and 6.42 show the phosphorus intakes from food sources and food and supplements, respectively. The median intake levels of phosphorus reported for the U.S. in NHANES III is similar to B.C. median intakes overall (Appendix R). As with calcium and magnesium, usual intake data from the U.S. were not available from the combination of food plus supplements for phosphorus and, thus, comparisons are not possible. Inadequate and excessive phosphorus intakes are not a problem for British Columbians as indicated in Tables 6.41 and 6.42.

Table 6.41 Phosphorus intakes from food sources by sex and age (expressed as mg/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles			EAR[2]	%<EAR	UL[3]	% > UL
				25th	50th	75th				
Male	19-30	142	1850 ± 79	1371	1723	2127	580	0	4000	<1
	31-50	205	1625 ± 50	1327	1589	1786	580	0	4000	0
	51-70	249	1492 ± 51	1183	1457	1696	580	2	4000	0
	71+	271	1333 ± 55	1046	1275	1461	580	0	3000	<1
Female	19-30	176	1230 ± 55	997	1120	1277	580	0	4000	0
	31-50	266	1151 ± 50	917	1069	1240	580	2	4000	0
	51-70	282	1134 ± 36	927	1065	1315	580	3	4000	0
	71+	230	1147 ± 38	901	1066	1292	580	2	3000	0

[1] SEM= Standard Error of the Mean.

[2] EAR = Estimated Average Requirement.

[3] UL=Tolerable Upper Intake Level.

Source: BBCA E451311-U11BV1 S.Hayward, August 2002.

Table 6.42 Phosphorus intakes from food sources and supplements by sex and age (expressed as mg/d)

Sex	Age	n	Mean ±	Percentiles			EAR[2]	%<EAR	UL[3]	% > UL
	(years)		SEM[1]	25th	50th	75th				
Male	19-30	142	1831 ± 43	1406	1725	2149	580	0	4000	<1
	31-50	205	1595 ± 21	1352	1596	1789	580	0	4000	0
	51-70	249	1500 ± 31	1212	1483	1715	580	2	4000	0
	71+	271	1333 ± 45	1067	1294	1511	580	0	3000	<1
Female	19-30	176	1156 ± 16	1004	1130	1294	580	0	4000	0
	31-50	266	1122 ± 17	919	1098	1260	580	2	4000	0
	51-70	282	1128 ± 21	931	1102	1321	580	3	4000	0
	71+	230	1148 ± 31	942	1119	1361	580	2	3000	0

[1] SEM= Standard Error of the Mean.

[2] EAR = Estimated Average Requirement.

[3] UL=Tolerable Upper Intake Level.

Source: BBCA E431311-011CV1 Supplement Tables- S. Hayward, August 2002.

6.4.5 Zinc

Zinc functions as a component of various enzymes in the maintenance of protein structure and the regulation of gene expression (Institute of Medicine, 2000). Inadequate zinc intakes are a concern for older British Columbians. Currently, there is interest in the potential role of zinc in the prevention and treatment of age-related eye disease (Hammond and Johnson, 2002). Because of zinc's role in proper immune system functioning and DNA synthesis, zinc supplementation is also being investigated in relation to prevention of some cancers.

Zinc intakes as estimated by the BCNS are found in Tables 6.43 and 6.44. Overall, the median intakes were similar to what has been observed in the U.S. for the adult population (Appendix R). However, slightly higher median intakes are reported for B.C. women over 50 years of age when supplement intake is included in the estimation than women in the U.S. in the same age group (Appendix R).

According to Table 6.43, a large proportion of British Columbians (7%-42%), especially those over 50 years of age, was below the EAR. Supplements helped to reduce the proportion below the EAR for the older age groups but essentially had no impact for the population under 50 (Table 6.44).

The UL for zinc is established at 40 mg per day. Even though excessive intakes of this nutrient are not a major problem for British Columbians, supplement use did contribute to a rise in the percentage above the UL (Tables 6.43 and 6.44).

Table 6.43 Zinc intakes from food sources by sex and age (expressed as mg/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles 25th	50th	75th	EAR[2]	%<EAR	UL[3]	% > UL
Male	19-30	142	15.6 ± 0.8	11.0	14.0	17.0	9.4	7	40	0
	31-50	205	15.1 ± 0.9	11.0	13.0	16.0	9.4	11	40	<1
	51-70	249	14.8 ± 2.0	9.4	12.0	15.0	9.4	26	40	3
	71+	271	11.3 ± 0.7	8.2	10.0	12.0	9.4	42	40	0
Female	19-30	176	9.6 ± 0.4	8.0	9.0	10.0	6.8	11	40	0
	31-50	266	9.8 ± 0.4	7.6	8.8	11.0	6.8	11	40	0
	51-70	282	11.1 ± 1.5	7.3	8.7	10.0	6.8	20	40	1
	71+	230	9.3 ± 0.4	7.1	8.1	9.8	6.8	19	40	0

[1] SEM= Standard Error of the Mean.

[2] EAR = Estimated Average Requirement.

[3] UL =Tolerable Upper Intake Level.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

Table 6.44 Zinc intakes from food sources and supplements by sex and age (expressed as mg/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles 25th	50th	75th	EAR[2]	%<EAR	UL[3]	% > UL
Male	19-30	142	19.1 ± 0.8	11.5	15.5	22.9	9.4	7	40	4
	31-50	205	15.7 ± 0.4	11.3	13.5	18.0	9.4	11	40	2
	51-70	249	17.1 ± 0.8	10.3	13.7	18.0	9.4	18	40	6
	71+	271	15.8 ± 1.3	8.7	11.3	18.0	9.4	33	40	6
Female	19-30	176	13.3 ± 0.9	8.2	9.5	12.4	6.8	8	40	3
	31-50	266	13.0 ± 0.5	7.8	9.8	14.7	6.8	10	40	1
	51-70	282	14.4 ± 0.8	8.0	10.1	17.0	6.8	13	40	3
	71+	230	16.3 ± 1.3	7.9	10.7	22.2	6.8	10	40	6

[1] SEM= Standard Error of the Mean.

[2] EAR = Estimated Average Requirement.

[3] UL =Tolerable Upper Intake Level.

Source: BBCA E431311-011CV1 Supplement Tables- S. Hayward, August 2002.

6.5 Electrolytes

6.5.1 Potassium and Sodium

Both potassium and sodium play important roles in maintaining normal blood pressure. The results for these two nutrients are included in the BCNS report (Tables 6.45 and 6.46) in anticipation of the release of the DRI report on electrolytes. However, current dietary guidance recommends that Canadians should limit their sodium intake (Health and Welfare Canada, 1990).

Table 6.45 Potassium intakes from food sources by sex and age (expressed as mg/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles		
				25th	50th	75th
Male	19-30	142	3800 ± 184	2846	3536	4231
	31-50	205	3594 ± 109	2944	3456	4057
	51-70	249	3509 ± 120	2653	3443	4159
	71+	271	3284± 100	2659	3181	3712
Female	19-30	176	2695 ± 117	2242	2502	2824
	31-50	266	2719 ± 95	2145	2568	2954
	51-70	282	2940 ± 88	2354	2786	3354
	71+	230	2726 ± 80	2211	2637	3113

[1] SEM= Standard Error of the Mean.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

Table 6.46 Sodium intakes from food fources by sex and age (expressed as mg/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles		
				25th	50th	75th
Male	19-30	142	4096 ± 172	3062	3855	4628
	31-50	205	3674 ± 146	2830	3534	4174
	51-70	249	3501 ± 187	2468	3034	3866
	71+	271	2637 ± 99	2001	2616	3019
Female	19-30	176	2695 ± 117	2129	2605	2898
	31-50	266	2593 ± 85	1908	2442	2960
	51-70	282	2271 ± 99	1722	2092	2507
	71+	230	2230 ± 178	1585	1870	2273

[1] SEM= Standard Error of the Mean.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

7.0 Conclusions

The BCNS was a major research undertaking that has contributed greatly to the knowledge and understanding of dietary intakes of adult British Columbians. The goal of the BCNS was to provide information that would guide policy development and service delivery in order to improve the nutritional health of British Columbians. The results of the BCNS provide, for the first time in over three decades, important information to assist health decision makers and program planners at the federal, provincial and regional levels to establish priorities and set public health and research agendas. Health educators will benefit from the findings by being able to target nutrition related interventions and consumers will benefit from the applications of these interventions. The results will help inform major health initiatives related to chronic disease prevention and health promotion and will be invaluable to the various stakeholders of B.C.

Estimates of usual nutrient intakes in this report represent intakes from food sources as well as supplements. The major findings on nutrient intakes of the B.C. adult population are highlighted below.

- Usual median intakes for food energy reported were slightly below recommended levels for most age-sex groups, suggesting that intakes were under-reported. These lower energy levels reported are doubtful, since more than 50% of the adult population were classified as being overweight or obese. This high prevalence of overweight and obesity indicates that energy balance is a major public health problem in B.C. As a result of slightly under-reported energy intakes, nutrient intakes may also have been slightly under-reported. This supports the need for future research to obtain biological confirmation of apparent dietary inadequacy.
- Two-thirds of British Columbians regularly consumed supplements, including nutritional and non-nutritional supplements. The major supplements taken in descending order were a combination of vitamins and minerals, vitamin C, vitamin E and various natural and herbal types. Nutritional supplements contributed to decreasing the proportion of inadequacy for several nutrients across age-sex groups.
- Most British Columbians fell in the acceptable macronutrient distribution ranges for carbohydrates (45%-65%), total fat (20%-35%) and protein (10%-35%). Even though most British Columbians fell within the acceptable range for total fat, about one-quarter were consuming more than 35% of their energy from fat sources.
- Overall, British Columbians had adequate intakes of thiamin, riboflavin, niacin and phosphorus.
- A substantial percentage of the population had inadequate intakes of folate, vitamin B12, vitamin B6, vitamin C, magnesium and zinc, identifying these nutrients as potential public health concerns.

- Median intakes of fibre and calcium were below recommendations for almost all age/sex groups, identifying these nutrients as potential public health concerns.
- Inadequate iron intakes were only a concern for pre-menopausal women.
- Excessive intakes of synthetic niacin were identified across all age-sex groups.

The BCNS served as an alert, identifying that the population is becoming more overweight and that supplement use including multiple supplement use is high. Food insecurity remains an issue for some. British Columbians appear to be consuming foods that are high in energy and low in several nutrients. Nutrients of concern include fibre, calcium, folate, vitamins B6, B12 and C, magnesium, zinc, iron (for pre-menopausal women) and niacin and saturated fat (due to excessive intake).

The BCNS will provide an important foundation for building public health policy and programs. In particular, the *Report on Food Group Use*, together with this report, will contribute to our understanding of the inadequacies observed for some of the nutrients of concern..

However, there is still considerable progress to be made in nutrition surveillance in Canada. While dietary intake data are useful, including physical measures and biochemical indices in a comprehensive nutrition surveillance and monitoring system will enhance the utility of the intake data. Currently, comparisons among other provinces cannot be made and thus, a national picture of dietary intakes still eludes us. Moreover, the BCNS was a general population study that surveyed the adult population and did not examine vulnerable subgroups of the population, most notably Aboriginal/First Nations people and children. The knowledge that the BCNS researchers have acquired from conducting this survey will be beneficial in guiding and partnering with other groups, such as Aboriginal groups in order to carry out complementary studies. Plans by Statistics Canada with CCHS, cycle 2.2 in 2004, to survey all age groups including children, for whom there is a striking paucity of data, are to be applauded.

A national surveillance system in Canada is imperative. McAmmond (2000) states that, "The gaps in Canada's food and nutrition surveillance capacity are extremely serious and must be remedied to promote and protect health. A systematic approach that improves and links existing data sources and develops new data sources is urgently needed." Health Canada and the provincial ministries must work together to ensure this initiative is brought to fruition.

8.0 References

Anderson SA. Core indicators of nutritional state for difficult-to-sample populations. *J Nutr* 1990;120:1559-1600.

Anonymous. Knowledge and use of folic acid among women of reproductive age-Michigan 1998. *MMWR* 2001;50(10):185-190.

Bailey LB, Moyers S, Gregory JF III. Folate, Chapter 21. In: Present Knowledge in Nutrition, 8th edition, eds. BA Bowman and RM Russell, Washington, DC: ILSI Press, 2001.

Barr SI, Broughton TL. Relative weight, weight loss efforts and nutrient intakes among health-conscious vegetarian, past vegetarian and nonvegetarian women aged 18 to 50. *J Am Coll Nutr* 2000;19:781-788.

Barr SI, Chrysomilides SA, Willis EJ, Beattie BL. Food intake of institutionalized women over 80 years of age. *J Can Diet Assoc* 1984;45:42-51.

Barr SI, Chrysomilides SA, Willis EJ, Beattie BL. Nutrient intakes of the old elderly: a study of female residents of a long-term care facility. *Nutr Res* 1983;3:417-431.

Barr SI, Janelle K, Prior JC. Vegetarian vs. nonvegetarian diets, dietary restraint and subclinical ovulatory disturbances: prospective six month study. *Am J Clin Nutr* 1994a;60:887-894.

Barr SI, Prior JC, Vigna YM. Restrained eating and ovulatory disturbances: possible implications for bone health. *Am J Clin Nutr* 1994b;59:92-97.

Barr SI. Secular trends in nutrient intakes of female nutrition students, 1986-1991. *Nutr Res* 1993;13:1099-1103.

Berger J, Wynder E. The correlation of epidemiological variables. *J Clin Epi* 1994;47:941-952.

Birmingham CL, Muller JL, Palepu A, Spinelli JJ, Anis AH. The cost of obesity in Canada. *CMAJ* 1999;160(4):483-8.

Black AE, Prentice AM, Goldberg GR, et al. Measurements of total energy expenditure provide insights into the validity of dietary measurement of energy intake. *J Am Diet Assoc* 1993;93:572-579.

Blair SN, Brodney S. Effects of physical inactivity and obesity on morbidity and mortality: current evidence and research issues. *Med Sci Sports Exer* 1999;31(11 Suppl):S646-62.

Blair SN, Kohl III HW, Barlow CE, Paffenbarger RS Jr, Gibbons LW, Maccra CA. Changes in physical fitness and all-cause mortality: a prospective study of healthy and unhealthy men. *JAMA* 1995;273:1093-1098.

Blumberg J. Nutritional needs of seniors. *J Am Coll Nutr* 1997;16:517-523.

Briefel RR, Sempos CT, McDowell MA, Chien S, Alaimo K. Dietary methods research in the third National Health and Nutrition Examination Survey: underreporting of energy intake. *Am J Clin Nutr* 1997;65(4 Suppl):1203S-1209S.

British Columbia Ministry of Health, Province of British Columbia and Health and Welfare Canada. British Columbia Heart Health Survey Report. Victoria: Ministry of Health and Ministry Responsible for Seniors, 1990.

British Columbia Ministry of Health, Office of the Provincial Health Officer. Health Goals for British Columbia, 1997. Available at: http://www.healthplanning.gov.bc.ca/pho/hlthgoals.html

British Columbia Ministry of Health. A report on the health of British Columbians. Provincial Health Officer's Annual Report, 1999. Victoria: B.C. Ministry of Health.

British Columbia Ministry of Health. B.C. Nutrition Survey Training and Resource Manual. Melanson C. editor, 1999b.

Buzzard M. 24 Hour Dietary Recall and Food Record Methods. In: Nutritional Epidemiology (2nd edition). Willett W. editor. New York: Oxford University Press, 1998.

Calle EE, Thun MJ, Petrelli JM, Rodriguez C, Heath CW Jr. Body-mass index and mortality in a prospective cohort of US adults. *N Engl J Med* 1999;341:1097-1105.

Canadian Dietetic Association. Hunger and food security in Canada: Official position of the Canadian Dietetic Association. *J Can Diet Assoc* 1991;52:139.

Canadian Facts and National Institute of Nutrition. Tracking Nutrition Trends 1989 – 1994 – 1997. Toronto: Canadian Facts, 1997.

Canadian Fitness and Lifestyle Research Institute. Meeting guidelines. Progress in Prevention Bulletin 31. Ottawa: Canadian Fitness and Lifestyle Research Institute, 1998.

Carlson SJ andrews MS, Bickel GW. Measuring food insecurity and hunger in the United States: Development of a national benchmark measure and prevalence estimates. *J Nutr* 1999;129:510S-5165S.

Che J, Chen J. Food insecurity in Canadian households. Health Reports, Health Statistics Division, Statistics Canada, Catalogue Number 82-003-XPE, 2001;12(4):11-22. Available at: www.statcan.ca/english/indepth/82-003/feature/ hrar2001012004s0a01.pdf

Craig CL, Russell SJ, Cameron C, Beaulieu A. Foundation for joint action: reducing physical inactivity. Ottawa: Canadian Fitness and Lifestyle Research Institute, 1999.

Czeizel AE, Dudas ID. Prevention of the first occurrence of neural tube defects by periconceptional vitamin supplementation. *N Engl J Med* 1992;327:1832-1835.

Daly S, Mills JL, Molloy AM, Conley M, Lee YJ, Kirke PN, Wier DG, Scott JM. Minimum effective dose of folic acid for food fortification to prevent neural tube defects. *Lancet* 1997;350:1666-1669.

Dietitians of Canada, B.C. Region and the Community Nutritionists Council of BC. The Cost of Eating in BC. Available at: http://www.dietitians.ca/members_only/pdf/cost_of_eating_in_BC_Oct2002.pdf . (Accessed November 5, 2002.)

Dietitians of Canada. Finding Solutions to Women's Nutrition and Healthy Eating Challenges. National Nutrition Month Campaign, 2003.

Earnshaw HL, Chapman GC, L.Milne R. Qualitative Evaluation of the B.C. Nutrition Survey – Reflections on the Experience and Process of Conducting a Provincial Nutrition Survey. Prepared for Ministry of Health, November 2000.

Federal, Provincial and Territorial Advisory Committee on Population Health. Statistical Report on the Health of Canadians. Ottawa: Minister of Public Works and Government Services Canada, 1999. (Catalogue Number H39-467/1999E)

Food and Drug Administration (FDA). Food standards: amendment of standards of identity for enriched grain products to require addition of folic acid. Federal Register 1996;61:8781-9797.

Frazao, E. High costs of poor eating patterns in the United States. America's Eating Habits: Changes and Consequences Ch. 1. Agriculture Information Bulletin No. 750, Economic Research Service, USDA, 1999. Available at: http://www.ers.usda.gov/publications/aib750a.pdf.

French MR, Barr SI, Levy-Milne R. Folate intakes and awareness of folate to prevent neural tube defects: A survey of women living inVancouver, Canada. *J Am Diet Assoc* 2003; 103:181-185.

Gariballa SE, Sinclair AJ. Nutrition, ageing and ill health. *Br J Nutr* 1998;80:7-23.

Godin G, Shephard, RJ. Simple method to assess exercise behavior in the community. *Can J of Applied Sport Science* 1985;10(3):141-146.

Government of British Columbia, Ministry of Finance and Corporate Relations. BC Stats. Population. Online at http://www.bcstats.gov.bc.ca/data/pop/pop/bcproj.htm (Accessed December 11, 2000).

Gray-Donald K, Jacobs-Starkey L, Johnson-Down L. Food habits of Canadians: Reduction in fat intake over a generation. *Can J Pub Health* 2000;91(5): 381-385.

Hamelin AM, Habicht JP, Beaudry M. Food insecurity: consequences for the household and broader social implications. *J Nutr* 1999;129:525S-528S.

Hammond BR, Johnson MA. The age-related eye disease study (AREDS). *Nutr Rev* 2002;60(9):283-288.

Health and Welfare Canada, Stephens T, Fowler Graham D, eds. Canada's Health Promotion Survey 1990. Technical Report. Ottawa: Minister of Supply and Services Canada, 1993 (Catalogue No. H39-263/2-1990E).

Health and Welfare Canada. Nutrition Recommendations. The Report of the Scientific Review Committee. Ottawa: Minister of Supply and Services Canada, 1990 (Catalogue No. H49-42/1990E.

Health and Welfare Canada. Promoting Healthy Weights: a Discussion Paper. Ottawa: Health Services and Promotion Branch, Department of National Health and Welfare, 1988. Catalogue number H39-131/1988E.

Health Canada and the Canadian Society for Exercise Physiology. Canada's Physical Activity Guide to Healthy Active Living. Ottawa: Health Canada, 1998.

Health Canada. Analysis of Non-response, Alberta Nutrition Survey 1994. BBCA 451311-006NR, Bureau of Biostatistics and Computer Applications, Food Directorate, Health Canada, 1999.

Health Canada. Canadian Guidelines for Body Weight Classification in Adults. 2003. Available at: http://www.hc-sc.gc.ca/hpfb-dgpsa/onpp-bppn/wieght_book_cp_e.html

Health Canada. Analysis of Non-response, B.C. Nutrition Survey 1999. BBCA 451311-0010NR, Bureau of Biostatistics and Computer Applications, Food Directorate, Health Canada, 2002.

Health Canada, Canadian Nutrient File, 1997.

Health Canada. Mandatory fortification of flour and pasta with folic acid-Schedule 1066, November 25, 1998. Regulatory Impact Analysis Statement. http://www.hc-sc.gc.ca/food-dietary reference intakes/folic acid_fortification.html (accessed January 2003).

Health Canada. Methodology for Estimating Usual Intake, B.C. Nutrition Survey 1999. BBCA 451311-0011NR, Bureau of Biostatistics and Computer Applications, Food Directorate, Health Canada, 2002.

Health Canada. Nutrient Intakes, B.C. Nutrition Survey 1999. BBCA E4451311-011BV1, Bureau of Biostatistics and Computer Applications, Food Directorate, Health Canada, 2002.

Health Canada. Supplement Report, B.C. Nutrition Survey 1999. BBCA E4451311-011CV1, Bureau of Biostatistics and Computer Applications, Food Directorate, Health Canada, 2002.

Heart and Stroke Foundation of Canada. Heart Disease and Stroke in Canada. Ottawa: Heart and Stroke Foundation of Canada, 1997a.

Heart and Stroke Foundation of Canada. Tobacco Use in B.C., 1997b. B.C. Ministry of Health. Available at: http://www.healthplanning.gov.bc.ca/tobacrs/index.html

Hibbard ED, Smithells RW. Folic acid metabolism and human embryopathy. *Lancet* 1965;1:1254.

Hooper M. Report on the 1994-1995 National Population Health Survey: Nutrition Component. Final Report (revised). Nutrition Programs Unit, Health Promotion and Programs Branch, Health Canada 1996 (unpublished report).

Howat PM, Mohan R, Champagne C, Monlezun C, Wozniak P, Bray GA. Validity and reliability of reported dietary intake data. *J Am Diet Assoc* 1994;94:169-173.

Institute of Medicine, Food and Nutrition Board. Dietary Reference Intakes for Calcium, Phosphorus, Magnesium, Vitamin D and Fluoride. A Report of the Standing Committee on the Scientific Evaluation of Dietary Reference Intakes and the Panel on Calcium and Related Nutrients. Washington DC: National Academy Press, 1997.

Institute of Medicine, Food and Nutrition Board. Dietary Reference Intakes for Thiamin, Riboflavin, Niacin, Vitamin B6, Folate, Vitamin B12, Pantothenic Acid, Biotin and Choline. A Report of the Standing Committee on the Scientific Evaluation of Dietary Reference Intakes and the Panel on Folate, Other B Vitamins and Choline and Subcommittee on Upper Reference Levels of Nutrients. Washington DC: National Academy Press, 1998.

Institute of Medicine, Food and Nutrition Board. Dietary Reference Intakes for Vitamin C, Vitamin E, Selenium and Carotenoids. A Report of the Panel on Antioxidants and Related Compounds, Subcommittees on Upper Reference Levels of Nutrients and Interpretation and Uses of Dietary Reference Intakes and the Standing Committee on the Scientific Evaluation of Dietary Reference Intakes. Washington DC: National Academy Press, 2000a.

Institute of Medicine, Food and Nutrition Board. Dietary Reference Intakes: Applications in Dietary Assessment. A Report of the Subcommittees on Interpretation and Uses of Dietary Reference Intakes and Upper Levels of Nutrients and the Standing Committee on the Scientific Evaluation of Dietary Reference Intakes. Washington DC: National Academy Press, 2000b.

Institute of Medicine, Food and Nutrition Board. Dietary Reference Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium and Zinc. A Report of the Panel on Antioxidants and Related Compounds, Subcommittees on Upper Reference Levels of Nutrients and Interpretation and Uses of Dietary Reference Intakes and the Standing Committee on the Scientific Evaluation of Dietary Reference Intakes. Washington DC: National Academy Press, 2001.

Institute of Medicine. Food & Nutrition Board Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein and Amino Acids. A Report of the Panel on Macronutrients, Panel on the Definition of Dietary Fibre, Subcommittee on Upper Reference Levels of Nutrients, Subcommittee on Interpretation and Uses of Dietary Reference Intakes and the Standing Committee on the Scientific Evaluation of Dietary Reference Intakes. Washington, DC: National Academy Press, 2002.

Janelle KC, Barr SI. Nutrient intakes and eating behavior scores of vegetarian and nonvegetarian women. *J Am Diet Assoc* 1995;95:180-186,189.

Karpinski K, Nargundkar M. Nova Scotia Nutrition Survey Methodology Report. Technical Document #E451311-001. Bureau of Biostatistics and Computer Applications, Food Directorate, Health Canada, 1992.

Katzmarzyk PT, Gledhill N, Shephard RJ. The economic burden of physical inactivity in Canada. *CMAJ* 2000;163:1435-1440.

Kelly M, Steele J, Nuttall N, Bradnock G, Morris J, Nunn J, Pine C, Pitts N, Treasure E, White D. Adult Dental Health Survey – Oral Health in the United Kingdom 1998. London: The Stationary Office, 2000.

Langille DB, Joffres MR, MacPherson KM andreou P, Kirkland SA, MacLean DR. Prevalence of risk factors for cardiovascular disease in Canadians 55 to 74 years of age: results from the Canadian Heart Health Surveys, 1986-1992. *CMAJ* 1999;161(8 Suppl): S3-S9.

Larkin FA, Basiotis PP, Riddick HA, Sykes KE, Pao EM. Dietary patterns of women smokers and non-smokers. *J Am Diet Assoc* 1990;90(2):230-237.

Laurence KM, James N, Miller MH, Tennant GB, Campbell H. Double blind randomized controlled trial of folate treatment before conception to prevent recurrence of neural tube defects. *Br Med J* 1981;282:1509-1511.

Lebenstedt M, Platte P, Pirke KM. Reduced resting metabolic rate in athletes with menstrual disorders. *Med Sci Sports Exerc* 1999;31:1250-1256.

Lee RD, Nieman DC. Nutrition Assessment, 3rd ed. Boston: McGraw Hill, 2003.

Leon AS, Rice T, Mandel S, Despres JP, Bergeron J, Gagnon J, Rao DC, Skinner JS, Wilmore JH, Bouchard C. Blood lipid response to 20 weeks of supervised exercise in a large biracial population: the HERITAGE Family Study. *Metab Clin Exp* 2000; 49(4):513-520.

Lesourd BM, Mazari L, Ferry M. The role of nutrition in immunity in the aged. *Nutr Rev* 1998;56(1 Pt 2):S113-125.

Macdonald, SM, Reeder, BA, Chen Y, Despres, J-P. Obesity in Canada: a descriptive analysis. *CMAJ* 1997;157(1S) Supplement:3S-9S.

Manson JE, Willett WC, Stampfer MJ, et al. Body weight and mortality among women. *N Engl J Med* 1995;333:677-685.

Marcus BH, Simkin LR. The stages of exercise behavior. J *Sports Med Phys Fitness* 1994;33(1):83-88.

McAmmond D and Associates, under contract with Health Canada. Food and Nutrition Surveillance in Canada: An Environmental Scan, 2000.

McLean JA, Barr SI, Prior JC. Cognitive dietary restraint is associated with higher urinary cortisol excretion in healthy premenopausal women. *Am J Clin Nutr* 2001a;72:7-12.

McLean JA, Barr SI, Prior JC. Dietary restraint, exercise and bone health in young women: are they related? *Med Sci Sports Exerc* 2001b;33:1292-1296.

McLean JA. Cognitive dietary restraint, food intake and cortisol excretion in premenopausal women. Vancouver B.C.: University of British Columbia , 1999 (doctoral dissertation).

McPhillips JB, Eaton CB, Gans KM, Derby CA, Lasater TM, McKenney JL, Carleton RA. Dietary differences in smokers and nonsmokers from two southeastern New England communities. *J Am Diet Assoc* 1994;94(3):287-292.

Mertz W, Tsui JC, Judd JT, et al. What are people really eating? The relation between energy intake derived from estimated dietary records and intake determined to maintain body weight. *Am J Clin Nutr* 1991;54:291-295.

MRC Vitamin Study Research Group. Prevention of neural tube defects: Results of the MRC vitamin study. *Lancet* 1991;338:11-137.

National Center for Health Statistics. Consensus workshop on Dietary Assessment: Nutrition Monitoring and Tracking the Year 2000 Objectives. Maryland: U.S. Department of Health and Human Services, 1994.

National Institute of Nutrition. Tracking Nutrition Trends 1989 – 1994 – 1997 – an update on Canadian's Attitudes, Knowledge and Reported Actions. Toronto: Canadian Facts, 1997.

National Research Centre. Nutrient Adequacy. National Academy Press, 1986.

National Task Force on the Prevention and Treatment of Obesity. Overweight, obesity and health risk. *Arch Intern Med* 2000;160:898-904.

Nova Scotia Department of Health. Report on the Nova Scotia Nutrition Survey. Halifax: Nova Scotia Heart Health Program, 1993.

Nusser SM, Carriquiry AL, Dodd KW, Fuller WA. A semiparametric transformation approach to estimating usual daily intake distributions. *J Am Stat Assoc* 1996;91:1440-1449.

Nutrition Canada. Food Consumption Patterns Report. Ottawa: Health and Welfare Canada, 1975a.

Nutrition Canada. Nutrition: A National Priority. Ottawa: Information Canada, 1973.

Nutrition Canada. The Saskatchewan Survey Report. Ottawa: Health and Welfare Canada, 1975b.

Olson CM. Nutrition and health outcomes associated with food insecurity and hunger. *J Nutr* 1999;129:521S-524S.

Osteoporosis Society of Canada. Consensus on calcium nutrition. Official position of the Osteoporosis Society of Canada. *Nutr Quart* 1993;18:62-69.

Pate RR, Pratt M, Blair SN, et al. Physical activity and public health: A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *JAMA* 1995;273:402-407.

Perez C. Fruit and vegetable consumption. Health Reports, Health Statistics Division, Statistics Canada, Catalogues number 82-003,2002;13(3). Available at www.statcan.ca/english/indepth/82-003/feature/hrar2002013003350a03.pdf

Physical activity and health: a report of the Surgeon General. Atlanta, GA: National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention, Department of Health and Human Services, 1996.

Prior JC, Vigna YM, Schechter MT, Burgess AE. Spinal bone loss and ovulatory disturbances. *N Engl J Med* 1990;323:1221-1227.

Quinlivan EP, Gregory III JF. Effect of food fortification on folic acid intake in the United States. *Am J Clin Nutr* 2003;77:221-225.

Radimer KL, Subar AF, Thompson FE. Nonvitamin, nonmineral dietary supplements: Issues and findings from NHANES III. J *Am Diet Assoc* 2000;100:447-454.

Rankinen T, Suomela-Markkanen T, Vaisanen S, Helminen A, Penttila I, Berg A, Bouchard C, Rauramaa R. Relationship between changes in physical activity and plasma insulin during a 2.5-year follow-up study. *Metab: Clin Exp* 1997;46(12):1418-2143.

Reeder BA, Chen Y, Macdonald SM, Angel A, Sweet L. Regional; and rural-urban differences in obesity in Canada. *CMAJ 1997;* 157(1S) Suppl:10S-16S.

Richards RG, Velicer WR, Prochaska JO, Rossi JS, Marcus BH. What makes a good staging algorithm: examples from regular exercise. *Am J Hlth Promo* 1997;12(1):57-66.

Rose D. Economic determinants and dietary consequences of food insecurity in the United States. *J Nutr* 1999;129:517S-520S.

Rose RC, Richer SP, Bode AM. Ocular oxidants and antioxidant protection. *Proc Soc Exp Biol Med* 1998;217:397-407.

Sante-Quebec. Les Quésbécoises et les Québécois-Mangent-ils mieux? Rapport de l'enquête Québécoise sur la nutrition, 1990. Montréal: Ministère se la Santé et des Services Sociaux, Gouvernement du Québec, 1995.

Sayers GM, Hughes N, Scallan E, Johnson A. A survey of knowledge and use of fólic acid among women of childbearing age in Dublin. *J Public Health Med* 1997;19:328-332.

Schoeller DA, Bandini LG, Dietz WH. Inaccuracies in self-reported intake identified by comparison with doubly labelled water method. *Can J Physiol Pharmacol* 1990;68:941-949.

Schweiger U, Tuschl RJ, Platte P, Broocks A, Laessle RG, Pirke KM. Everyday eating behavior and menstrual function in young women. *Fertil Steril* 1992;57:771-775.

Smithells RW, Nevin NC, Seller MJ, Sheppard S, Harris R, Read AP, Fielding DW, Walker S, Schorah CJ, Wild J. Further experience of vitamin supplementation for prevention of neural tube defect recurrences. *Lancet* 1983;1:1027-1031.

Smithells RW, Sheppard S, Schorah CJ. Vitamin deficiencies and neural tube defects. *Arch Dis Child* 1976; 61:944-950.

Statistics Canada, Household Surveys Division, Family Expenditure Survey. Family food expenditure in Canada, selected cities, 1984. Ottawa: Minister of Supply and Services Canada, 1986 (Catalogue Number 62-554).

Statistics Canada. Income Trends in Canada 1990-1999 Before Tax. Ottawa: Income Statistics Division, 2001 (Catalogue Number 75-F0002M-01007.

Statistics Canada. Food consumption in Canada, Part I, 1996. Ottawa: Minister of Industry, 1997a. (Catalogue Number 32-229-XPB).

Statistics Canada. Food consumption in Canada, Part II, 1996. Ottawa: Minister of Industry, 1997b. (Catalogue Number 32-230-XPB).

Statistics Canada. Health Indicators, Volume 2002, Number 1. (Statistics Canada Catalogue Number 82-221-XIE. Available on-line at http://www.statcan.ca/english/freepub/82-221-XIE/00502/toc.htm (Accessed June 18, 2002).

Statistics Canada. National Population Health Survey Overview, 1996-97. Ottawa: Minister of Industry, 1998 (Statistics Canada Cat. No. 82-567-XPB).

Statistics Canada. Standards and guidelines for reporting of non-response rates:definitions, framework and detailed guidelines. Statistics Canada Methods and Standards Committee, 1992.

Statistics Canada. 1996 Census. 2.8% microdata sample (July 12, 2000 download).

Statistics Canada. Canadian statistics. Population. Population projections for 2001, 1006, 2011, 2016, 2021 and 2026, July1. http://www.statcan.ca/english/Pgdb/People/Population/demo23a.htm (Accessed December 11, 2000).

Statistics Canada. Taking Risks/Taking Care. Health Reports 12(3), Catalogue 82-003,January 16, 2003.

Stephen AM, Reeder BA. Saskatchewan Nutrition Survey. Report of a survey in the province of Saskatchewan, 1993-1994. Saskatoon: University of Saskatchewan, 2001.

Stunkard AJ, Messick S. The three-factor eating questionnaire to measure dietary restraint, disinhibition and hunger. *J Psychosom Res* 1985;29:71-83.

Subar AF, Harlan LC, Mattson ME. Food and nutrient intake differences between smokers and non-smokers in the U.S. *Am J Public Health* 1990;80:1323-1329.

Tarasuk VS, Beaton GH. Women's dietary intakes in the context of household food insecurity. *J Nutr 1999;*129:672-679.

Taylor J, vanTil L, MacLennan D. Prince Edward Island Nutrition Survey. Charlottetown: University of PEI, 2002.

Trabulsi J, Schoeller DA. Evaluation of dietary assessment instruments against doubly water, a biomarker of habitual energy intake. *Am J Physiol-Endocrinology & Metabolism.* 2001;281(5):E891-E899.

Trakas K, Lawrence K, Shear NH. Utilization of health care resources by obese Canadians. *CMAJ 1999;*160(10):1457-1462.

Tremblay MS, Willms JD. Secular trends in the body mass index of Canadian children. *CMAJ 2000;*163:1429-1433.

Troppmann L, Gray-Donald K, Johns T. Supplement use is there any nutritional benefit? *J Am Diet Assoc* 2002;102(6):818-825.

Tucker KL, Selhub J, Wilson PF, Rosenberg IH. Dietary intake pattern relates to plasma folate and homocysteine concentrations in the Framingham Heart Study. *J Nutr* 1996;126:3025-3031.

United States Department of Agriculture, Food Surveys Research Group. Data tables: Results from USDA's 1994-96 Continuing Survey of Food Intakes by Individuals and 1994-96 Diet and Health Knowledge Survey, [Online]. Food Surveys Research Group. Available at: http://www.barc.usda.gov/bhnrc/foodsurvey/pdf/Csfii3yr.pdf (website accessed December 21, 2000).

United States Department of Health and Human Services. National Centre for Health Statistics, Third National Health and Nutrition Examination Survey (NHANES) 1988-1994. Hyattsville, Md: Centre for Disease Control and Prevention. www.cdc.gov/nchs/nhanes.htm, accessed July 2003.

United States Department of Agriculture. Interagency Board for Monitoring and Related Research. Third Report on Nutrition Monitoring in the United States. Executive Summary. Washington:U.S. Government Printing Office,1995.

Vailas LI, Nitzke SA, Becker M, Gast J. Risk indicators for malnutrition are associated inversely with quality of life for participants in meal programs for older adults. *J Am Diet Assoc* 1998;98:548-553.

Vergel RG.,Snachez LR, Heredero BL., Rodriguez PL., Marinez AJ. Primary prevention of neural tube defects with folic acid supplementation. Cuban experience. *Prenatal Diagnosis* 1990;10:149-152.

Weddle D, Wellmlan NS, Shoaf LR. Position of the American Dietetic Association: nutrition, aging and the continuum of care. *J Am Diet Assoc* 1996;96:1048-1052.

Wei M, Kampert JB, Barlow CE, Nichaman MZ, Gibbons LW, Paffenbarger RS, Blair SN. Relationship between low cardiorespiratory fitness and mortality in normal-weight, overweight and obese men. *JAMA* 1999;282:1547-1553.

Willett WC, Stampfer MJ. What vitamins should I be taking, doctor? *N Engl J Med* 2001;345:1819-1824.

Wilmore JH, Despres JP, Stanforth PR, Mandel S, Rice T, Gagnon J, Leon AS, Rao D, Skinner JS, Bouchard C. Alterations in body weight and composition consequent to 20 wk of endurance training: the HERITAGE Family Study. *Am J Clin Nutr* 1999; 70(3):346-352.

World Health Organization. Obesity: Preventing and managing the global epidemic. In: Report of a WHO Consultation on Obesity, Geneva, June 3-5, 1997. Geneva: World Health Organization, 1998.

Yates JRW, Ferguson-Smith MA, Shenkin A, Guzman-Rodriguez R, White M, Clarke BJ. Is disordered folate metabolism the basis for the genetic predisposition to neural tube defects? *Clin Gen* 1987;31:279-287.

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Appendix A

Sample Design Specifications

BRITISH COLUMBIA NUTRITION SURVEY

Sample Design specifications

For British Columbia Ministry of Health

France Bilocq
Statistical Consultation Group
Statistics Canada
March 1, 1999

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1. INTRODUCTION

The main objective of the British Columbia Nutrition Survey (BCNS) is to obtain information on the dietary practices of adults aged 18 to 84. The data will be collected during a face to face interview. Half of the sample will be interviewed during the Spring of 1999 and the other half in the Fall of 1999. Each season, one third of the sample will be re-interviewed in order to measure intra-personal variation of food intake.

2. TARGET POPULATION

The target population comprises all persons aged 18 to 84, living in British Columbia (BC) at the time of the survey. Persons living in institutions or on Indian Reserves are excluded. Furthermore, pregnant women, lactating women and military living on a military base will be excluded from the survey when identified by the nurses during the interview.

A set of remote areas (based on 1996 Census sub-division CSD's) were identified by the Client. These remote areas are excluded from data collection but are still part of the population under study. This will be taken into account when post-stratification will be performed. Once Indian Reserves are excluded the remote areas account for 3.8% of the population.

3. GEOGRAPHIC STRATIFICATION

The Client divided the list of in-scope CSD's in three geographic strata: Metro, Coastal and Non-Metro Interior and further divided the Metro stratum into 6 sub-strata. The geographic strata are:

- Stratum 1: Metro
    - Sub-stratum 1: Vancouver
    - Sub-stratum 2: Victoria
    - Sub-stratum 3: Nanaimo
    - Sub-stratum 4: Kamloops
    - Sub-stratum 5: Kelowna
    - Sub-stratum 6: Prince Georges

- Stratum 2: Coastal
- Stratum 3: Non-metro interior

The non-metro interior stratum was split into 10 clusters in order to reduce the cost of travel associated with data collection.

Appendix 1A provides a list of in-scope CSD's for stratum 1 (sub-strata 1 to 6), stratum 2 and stratum 3 (clusters 1 to 10).

4. THE SAMPLING DESIGN

The sample for the BC Nutrition Survey will be drawn according to a two-stage probability sample design.

1. The first stage

At the first stage, stratum 1 (sub-strata 1 to 6) and stratum 2 are chosen with certainty (probability=1).
As mentioned earlier, stratum 3 has been divided into 10 clusters. The first stage of the sampling design for stratum 3 has been performed by Statistics Canada (STC). A sample of 4 clusters has been randomly chosen with probability proportional to the population size of the clusters. The selected clusters are # 2, 4, 6 and 8 according to the numbering presented in Appendix 1A.

NOTE: For estimation purposes, there was a need to select more then two clusters. A sample of three clusters was not felt to be sufficient and a sample of five clusters seemed to fragment the overall sample too much and jeopardise the purpose of clustering: cost savings.

Appendix 1B presents a summary of Appendix 1A at the stratum/sub-stratum/cluster level and also provides the first stage sampling weights.

2. The second stage

At the second stage, the client will select, from the British Columbia Health Register (BCHR), a sample of individuals within sub-strata 1, 2, 3, 4, 5, 6, stratum 2 and clusters # 2, 4, 6 and 8 according to the selection procedure described in section 4.7.

a. The second stage sampling frame

For sub-strata 1, 2, 3, 4, 5, 6 and stratum 2, the second stage sampling frame comprises the in-scope individuals of the BCHR who are aged (or will be aged) 18 to 84 at the time of the Spring collection and lives in the CSD's identified for these areas (see Appendix 1A).

For stratum 3, the second stage sampling frame comprises the in-scope individuals of the BCHR who are aged (or will be aged) 18 to 84 at the time of the Spring collection and lives in the CSD's included in the first stage selected clusters, # 2, 4, 6 and 8 (see Appendix 1A).

b. The second stage age-sex stratification

The sub-strata 1, 2, 3, 4, 5, 6, stratum 2 and each selected cluster of stratum 3 will be stratified according to the following 14 age-sex strata:

1. 18-24 years old male
2. 25-34 years old male
3. 35-44 years old male
4. 45-54 years old male
5. 55-64 years old male
6. 64-74 years old male
7. 75-84 years old male
8. 18-24 years old female
9. 25-34 years old female
10. 35-44 years old female
11. 45-54 years old female
12. 55-64 years old female
13. 64-74 years old female
14. 75-84 years old female

3. Sample size

An effective sample size of 2,200 respondents aged 18 to 74 plus an effective sample size of 500 respondents aged 75 to 84 is expected to give a provincial estimates of a proportion of a certain characteristic precise within .02 at a 95% level of confidence. That is, the true value of a proportion is expected to belong in the interval ****** where correspond to the estimates from the survey. The expected (effective) sample size needs to be corrected to account for frame problems and non-response. In general, administrative registers suffer from some amount of "out-of-datedness", and data collection experiences with the BC Health Register showed around 20% of non-contact. Let's suppose a hit rate of 80% of the selected individuals.

An additional reduction of the original sample size will be caused by non-response (not-at-home, refusal, etc.). The Client provided the non-response factors by age group.

The next table presents the expected sample size, the expected precision and the sample size corrected for out-of-datedness and for non-response. For information, the derived non-response rate was calculated.

TABLE 1

A	B	C	D	E	F	G
Age-sex Strata	**Expected Sample Size**	**Expected Precision 95%**	**Out/date Rate**	**Non-Response Factor**	**Corrected Sample size**	**Derived Non-response Rate**
					B/(1-D)*E	
M18-24	170	.08	0,20	2,00	425	0,50
M25-34	170	.08	0,20	2,00	425	0,50
M35-44	170	.08	0,20	1,50	319	0,33
M45-54	170	.08	0,20	1,30	276	0,23
M55-64	170	.08	0,20	1,30	276	0,23
M65-74	250	.06	0,20	1,40	438	0,29
M75-84	250	.06	0,20	1,50	469	0,33
F18-24	170	.08	0,20	2,00	425	0,50
F25-34	170	.08	0,20	2,00	425	0,50
F35-44	170	.08	0,20	1,50	319	0,33
F45-54	170	.08	0,20	1,30	276	0,23
F55-64	170	.08	0,20	1,30	276	0,23
F65-74	250	.06	0,20	1,40	438	0,29
F75-84	250	.06	0,20	1,50	469	0,33
Total	2700	.02			5256	

4. *Allocation*

The sample was allocated to the age-sex and geographic strata according to the following steps:

a) Allocation to age-sex strata:

As viewed in Table 1, column B, a sample of 250 was allocated to ages 65-74 and 75-84 for both male and female and a sample of 170 was allocated to the remaining age-sex strata.

a) The out-of-datedness rate and the non-response factor were applied to each age-sex stratum (see column F: Corrected sample size in Table 1).

b) The allocation to metro, coastal and non-metro interior strata (strata 1,2 and 3) was done proportionally to their (population size) $^{1/3}$.

c) The allocation to sub-strata 1 to 6 was done proportionally to their (population size)$^{1/3}$

d) Finally, the sample size was allocated equally to the four selected cluster of stratum 3.

The following table provides the results (in proportion) of the allocation for the geographic strata/sub-strata/clusters.

TABLE 2: **Results of the allocation (in proportion)**

Strata	Sub Strata	Clusters	Allocation (proportion)	Total by strata
1	1	-	0,1600	0,4700
1	2	-	0,0800	
1	3	-	0,0500	
1	4	-	0,0600	
1	5	-	0,0600	
1	6	-	0,0600	
2	-	-	0,2400	0,2400
3	-	2	0,0725	0,2900
3	-	4	0,0725	
3	-	6	0,0725	
3	-	8	0,0725	
Total			1,0000	1,0000

Note: The allocation was performed proportionally to (population size) $^{1/3}$ instead of proportional to size or to square root of size because of the discrepancy between the population size of the strata. This method gives less importance to the largest strata and more to the smaller ones. For example stratum 1 represents 74% of the population of the 3 strata, stratum 2 represents 10% and stratum 3 represents 16%. Using allocation proportional to (population size) $^{1/3}$, 47% of the sample was allocated to the metro stratum, 24% to coastal stratum and 29 % to the non-metro interior stratum.

The results of the allocation were applied to the corrected sample size of each age-sex strata (column F in Table 1) to determine the samples size of the geographic strata. The resulting sample sizes were then rounded to the nearest higher multiple of two for the purpose of Spring/Fall collection split.

Appendix 2 provides the following six tables.

Table A:	The expected sample sizes for each geographic/age-sex stratum
Table B:	The expected sample sizes for Spring or Fall collection (Table A 2)
Table C:	The expected sample sizes for Spring or Fall second 24-hour recall collection (Table B 3)
Table D:	The corrected sample sizes for each geographic/age-sex stratum
Table E:	The corrected sample sizes for Spring or Fall collection (Table D 2)
Table F:	The corrected sample sizes for Spring or Fall second 24-hour recall collection (Table E 3)

5. *Selection procedure*

To simplify the notation, the sub-strata, stratum 2 and selected clusters will now be referred to as geographic groups. Sub-strata 1 to 6 become groups 1 to 6 respectively, strata 2 becomes group 7 and selected clusters # 2, 4, 6 and 8 become group 8, 9, 10 and 11 respectively. The Client will select from the BC Health Register, a systematic random sample of individuals within each geographic group/age-sex combination.

In order to describe the selection method let's use the following notation:

h	The geographic groups, $h = 1, 2, 3, \ldots, 11$
a	The age-sex stratum, $a = 1, \ldots, 14$
N_{ha}	The number of in-scope persons available on the BC Health Register in the age-sex stratum a, in the geographic group h.

n_{ha}	The number of persons to be selected on the BC Health Register in the age-sex stratum a, in the geographic group h (see Appendix 2, Table D).
ha:	Geographic group/age-sex combination
I_{ha}	The sampling interval for stratum ha: $I_{ha} = N_{ha} / n_{ha}$
U_{ha}	The random start for the sample selection of individual in the geographic group/age-sex "ha": $1 < U_{ha} < I_{ha}$

The following 10 steps describes the method that will be used to select a sample of individuals in each geographic group/age-sex combination. Steps 1 to 10 are to be executed for each "ha" combination.

Appendix 3 contains a diagram that outlines the steps of the selection method.

Step 1: Generate a random number for each person

Step 2: In order to insure a good representation of each CSD and remove potential bias in the selection, the list of persons is sorted by CSD's, and by random number within CSD's.

Step 3: Select the $(U_{ha})^{th}$, $(U_{ha}+I_{ha})^{th}$, $(U_{ha}+2I_{ha})^{th}$,...,$(U_{ha}+(n_{ha}-1)I_{ha})^{th}$ persons on the list.

Lets identify the selected persons in "ha" as P_{ha1}, P_{ha2},..., $P_{ha(nha)}$

NOTE: The sample sizes obtained from the systematic sampling may differ slightly from the sample sizes in Table D (APPENDIX 2). The obtained sample sizes are noted: n_{ha}

IMPORTANT: The population size N_{ha} and the obtained sample size n_{ha} are to be stored for the calculation of the estimation weights.

Step 4: Every second person selected is *de facto* assigned to the Fall collection namely persons P_{ha2}, P_{ha4}, P_{ha6}, ... Lets rename and renumber the Fall collection persons to F_{ha1}, F_{ha2}, F_{ha3}, ...

The other selected persons, namely P_{ha1}, P_{ha3}, P_{ha5}, ... are assigned to the Spring collection. Lets rename and renumber the Spring collection persons to S_{ha1}, S_{ha2}, S_{ha3}.

Create a flag to identify the collection season.

NOTE: Steps 5, 6 and 7 are identical to steps 8, 9 and 10. The first three apply to the Spring collection and the last three to the Fall Collection.

Step 5: Let's assign the days of the week for the first 24-hour recall of the Spring collection according to the following:

S_{ha1}, S_{ha8}, S_{ha15},... to Monday, c=1
S_{ha2}, S_{ha9}, S_{ha16},... to Tuesday, c=2
S_{ha3}, S_{ha10}, S_{ha17},... to Wednesday, c=3
S_{ha4}, S_{ha11}, S_{ha18},... to Thursday, c=4
S_{ha5}, S_{ha12}, S_{ha19},... to Friday, c=5
S_{ha6}, S_{ha13}, S_{ha20},... to Saturday, c=6
S_{ha7}, S_{ha14}, S_{ha21},... to Sunday, c=7

Create a variable "c= 1, 2, ... 7" to identify the day for the first 24-hour recall of the Spring collection.

Step 6: Every third person selected for the Spring collection is assigned to the second 24-hour recall; namely, persons S_{ha3}, S_{ha6}, S_{ha9}.

Generate a new random number for each person chosen for the second 24-hour recall of Spring. Sort these persons according to the new random number.

Lets rename and renumber the second 24-hour recall sample of the Spring collection $SR_{ha1}, SR_{ha2}, SR_{ha3}$

Create a flag to identify the participants in the second 24-hour recall.

Step 7: Lets assign the days of the week for the second 24-hour recall sample of the Spring collection according to the following:

$SR_{ha1}, SR_{ha8}, SR_{ha15}$,... to Monday, d=1
$SR_{ha2}, SR_{ha9}, SR_{ha16}$... to Tuesday, d=2
$SR_{ha3}, SR_{ha10}, SR_{ha17}$... to Wednesday, d=3
$SR_{ha4}, SR_{ha11}, SR_{ha18}$,... to Thursday, d=4
$SR_{ha5}, SR_{ha12}, SR_{ha19}$,... to Friday, d=5
$SR_{ha6}, SR_{ha13}, SR_{ha20}$,... to Saturday, d=6
$SR_{ha7}, SR_{ha14}, SR_{ha21}$,... to Sunday, d=7

Create a variable "d= 1, 2, … 7" to identify the day for the second 24-hour recall of the Spring collection.

Step 8: Let's assign the days of the week for the first 24-hour recall of the Fall collection according to the following:

$F_{ha1}, F_{ha8}, F_{ha15}$,... to Monday, c=1
$F_{ha2}, F_{ha9}, F_{ha16}$,... to Tuesday, c=2
$F_{ha3}, F_{ha10}, F_{ha17}$,... to Wednesday, c=3
$F_{ha4}, F_{ha11}, F_{ha18}$,... to Thursday, c=4
$F_{ha5}, F_{ha12}, F_{ha19}$,... to Friday, c=5
$F_{ha6}, F_{ha13}, F_{ha20}$,... to Saturday, c=6
$F_{ha7}, F_{ha14}, F_{ha21}$,... to Sunday c=7

Create a variable "c= 1, 2, … 7" to identify the day for the first 24-hour recall of the Fall collection.

Step 9: Every third person selected for the Fall collection is assigned to the second 24-hour recall; namely, persons $F_{ha3}, F_{ha6}, F_{ha9}$,

Generate a new random number for each person chosen for the second 24-hour recall of Fall. Sort these persons according to the new random number.

Lets rename and renumber the second 24-hour recall sample of the Fall collection $FR_{ha1}, FR_{ha2}, FR_{ha3}$...

Create a flag to identify the participants in the second 24-hour recall.

Step 10: Lets assign the days of the week for the second 24-hour recall sample of the Fall collection according to the following:

$FR_{ha1}, FR_{ha8}, FR_{ha15}$,... to Monday, d=1
$FR_{ha2}, FR_{ha9}, FR_{ha16}$,... to Tuesday, d=2
$FR_{ha3}, FR_{ha10}, FR_{ha17}$,... to Wednesday, d=3
$FR_{ha4}, FR_{ha11}, FR_{ha18}$,... to Thursday d=4
$FR_{ha5}, FR_{ha12}, FR_{ha19}$,... to Friday, d=5
$FR_{ha6}, FR_{ha13}, FR_{ha20}$,... to Saturday, d=6
$FR_{ha7}, FR_{ha14}, FR_{ha21}$,... to Sunday, d=7

Create a variable "d= 1, 2, … 7" to identify the day for the second 24-hour recall of the Fall collection.

Recommendation:

The address and phone number of the individuals included in the Fall sample should be updated using the B. C. Health Register just prior to the Fall collection in order to maximise contacts.

5. OUTPUTS

1. From the selection process

The following items of information are to be computed and retained for later use (questionnaire labels, reference lists, other):

1) Sequential identifier (create one if needed)
2) Geographic group (= *h*)
3) Age-sex stratum (= *a*)
4) The flag for the Spring/Fall collection
5) The day for the first 24 hour recall (=c)
6) The flag indicating participation in second 24-hour recall
7) The day for the second 24 hour recall (=d)
8) Full name of the selected person
9) Full address of the selected person
10) Telephone number
11) Standard geographic code: Census Sub-Division (CSD).

2. For weighting and estimation process

The following information need to be stored and provided to STC and Health Canada for weighting and estimation purposes:

1) CSD number (standard geographic code)

2) Geographic group (= h)

3) Age-sex stratum (= a)

4) The BCHR population size (N_{ha}) for each geographic group/age-sex combination

5) The obtained sample sizes (n_{ha}), i.e. the sample sizes resulting from the systematic sampling.

APPENDIX 1A The list of CSD's by stratum sub-stratum and cluster

Stratum	Sub-str	Cluster	CSD	NAME	Population
1	1		5909052	Abbotsford	105 403
1	1		5909056	Mission	30 519
1	1		5909054	Fraser Valley, Subd. D	356
1	1		5915022	Vancouver	514 008
1	1		5915004	Surrey	304 477
1	1		5915025	Burnaby	179 209
1	1		5915015	Richmond	148 867
1	1		5915034	Coquitlam	101 820
1	1		5915011	Delta	95 411
1	1		5915046	North Vancouver	80 418
1	1		5915001	Langley	80 179
1	1		5915075	Maple Ridge	56 173
1	1		5915029	New Westminster	49 350
1	1		5915039	Port Coquitlam	46 682
1	1		5915051	North Vancouver	41 475
1	1		5915055	West Vancouver	40 882
1	1		5915002	Langley	22 523
1	1		5915043	Port Moody	20 847
1	1		5915007	White Rock	17 210
1	1		5915070	Pitt Meadows	13 436
1	1		5915018	University Endowment Area	6 833
1	1		5915063	Greater Vancouver, Subd. A	3 066
1	1		5915065	Lions Bay	1 347
1	1		5915038	Anmore	961
1	1		5915036	Belcarra	665
1	2		5917021	Saanich	101 388
1	2		5917034	Victoria	73 504
1	2		5917030	Oak Bay	17 865
1	2		5917044	Langford	17 484
1	2		5917040	Esquimalt	16 151
1	2		5917015	Central Saanich	14 611
1	2		5917041	Colwood	13 848
1	2		5917051	Capital, Subd. C	11 432
1	2		5917010	Sidney	10 701
1	2		5917005	North Saanich	10 411
1	2		5917047	View Royal	6 441
1	2		5917042	Metchosin	4 709
1	2		5917049	Highlands	1 423
1	2		5917045	Capital, Subd. B	603

1	3		5921007	Nanaimo	70 130
1	4		5933042	Kamloops	76 394
1	4		5933040	Thompson-Nicola, Subd. B	4 668
1	5		5935010	Kelowna	89 442
1	5		5935023	Central Okanagan, Subd. B	22 901
1	6		5953023	Prince George	75 150
2			5929005	Gibsons	3 732
2			5929011	Sechelt	7 343
2			5929020	Sunshine Coast, Subd. A	13 075
2			5931006	Squamish	13 994
2			5917025	Capital, Subd. A	13 405
2			5917055	Capital, Subd. D	207
2			5919008	North Cowichan	25 305
2			5919012	Duncan	4 583
2			5919014	Cowichan Valley, Subd. B	7 376
2			5919016	Lake Cowichan	2 856
2			5919021	Ladysmith	6 456
2			5919031	Cowichan Valley, Subd. A	3 190
2			5919045	Cowichan Valley, Subd. C	14 137
2			5919047	Cowichan Valley, Subd. D	3 959
2			5921012	Nanaimo, Subd. A	14 837
2			5921018	Parksville	9 472
2			5921023	Qualicum Beach	6 728
2			5921028	Nanaimo, Subd. B	19 930
2			5923008	Port Alberni	18 468
2			5923019	Ucluelet	1 658
2			5923025	Tofino	1 170
2			5923031	Alberni-Clayoquot, Subd. A	7 904
2			5923045	Alberni-Clayoquot, Subd. B	742
2			5925005	Comox	11 069
2			5925010	Courtenay	17 335
2			5925014	Cumberland	2 548
2			5925020	Comox-Strathcona, Subd. C	23 746
2			5925025	Gold River	2 041
2			5925034	Campbell River	28 851
2			5925039	Sayward	440
2			5925044	Comox-Strathcona, Subd. B	5 469
2			5925047	Comox-Strathcona, Subd. D	205
2			5927008	Powell River	13 131
2			5927014	Powell River, Subd. A	6 207
2			5943008	Alert Bay	612
2			5943012	Port McNeill	2 925
2			5943017	Port Alice	1 331
2			5943023	Port Hardy	5 283

2			5947007	Port Edward	700
2			5947012	Prince Rupert	16 714
2			5949005	Kitimat	11 136
3		1	5901012	Fernie	4 877
3		1	5901022	Cranbrook	18 131
3		1	5901028	Kimberley	6 738
3		1	5901039	Invermere	2 687
3		1	5901040	Radium Hot Springs	530
3		1	5903004	Creston	4 816
3		1	5903008	Central Kootenay, Subd. C	8 017
3		2	5903011	Salmo	1 202
3		2	5903015	Nelson	9 585
3		2	5903019	Slocan	335
3		2	5903023	Kaslo	1 063
3		2	5903027	Silverton	241
3		2	5903032	New Denver	579
3		2	5903037	Central Kootenay, Subd. B	15 354
3		2	5903045	Castlegar	7 027
3		2	5903050	Nakusp	1 736
3		2	5903054	Central Kootenay, Subd. A	8 031
3		2	5905005	Fruitvale	2 117
3		2	5905009	Montrose	1 137
3		2	5905014	Trail	7 696
3		2	5905018	Warfield	1 788
3		2	5905023	Rossland	3 802
3		2	5905028	Kootenay Boundary, Subd. A	3 968
3		2	5905032	Grand Forks	3 994
3		2	5905037	Midway	686
3		2	5905042	Greenwood	784
3		3	5907005	Osoyoos	4 021
3		3	5907009	Keremeos	1 167
3		3	5907014	Oliver	4 285
3		3	5907020	Okanagan-Similkameen, Subd. B	9 051
3		3	5907024	Princeton	2 826
3		3	5907035	Summerland	10 584
3		3	5907041	Penticton	30 987
3		3	5907045	Okanagan-Similkameen, Subd. A	9 216
3		3	5935016	Lake Country	9 007
3		3	5935018	Peachland	4 524
3		4	5909009	Hope	6 247
3		4	5909020	Chilliwack	60 186
3		4	5909027	Harrison Hot Springs	898
3		4	5909032	Kent	4 844

3		4	5909038	Fraser Valley, Subd. B	4 191
3		4	5909058	Fraser Valley, Subd. E	3 637
3		4	5931012	Pemberton	855
3		4	5931020	Whistler	7 172
3		5	5931024	Lillooet	1 988
3		5	5933006	Merritt	7 631
3		5	5933015	Lytton	322
3		5	5933019	Ashcroft	1 858
3		5	5933024	Cache Creek	1 115
3		5	5933028	Clinton	729
3		5	5933035	Logan Lake	2 492
3		5	5933054	Chase	2 460
3		5	5933058	Thompson-Nicola, Subd. E	2 849
3		5	5933066	Thompson-Nicola, Subd. A	8 591
3		6	5937005	Lumby	1 689
3		6	5937010	Coldstream	8 975
3		6	5937014	Vernon	31 817
3		6	5937019	North Okanagan, Subd. B	11 017
3		6	5937024	Spallumcheen	5 322
3		6	5937028	Armstrong	3 906
3		6	5937033	Enderby	2 754
3		6	5939019	Revelstoke	8 047
3		6	5939032	Salmon Arm	14 664
3		6	5939041	Columbia-Shuswap, Subd. C	13 857
3		6	5939045	Sicamous	2 827
3		7	5941005	One Hundred Mile House	1 850
3		7	5941009	Williams Lake	10 472
3		7	5941011	Cariboo, Subd. B	25 167
3		7	5941013	Quesnel	8 468
3		7	5941023	Cariboo, Subd. A	16 630
3		8	5949011	Terrace	12 779
3		8	5949016	Kitimat-Stikine, Subd. C	7 818
3		8	5949022	Hazelton	347
3		8	5949024	New Hazelton	822
3		8	5949026	Kitimat-Stikine, Subd. B	2 098
3		8	5951034	Houston	3 934
3		8	5951038	Telkwa	1 194
3		8	5951043	Smithers	5 624
3		9	5951007	Vanderhoof	4 401
3		9	5951009	Fraser Lake	1 344
3		9	5951013	Fort St. James	2 046
3		9	5951022	Burns Lake	1 793
3		9	5951032	Granisle	446
3		9	5953007	Valemount	1 303

3		9	5953012	McBride	740
3		9	5953033	Mackenzie	5 997
3		10	5955005	Pouce Coupe	894
3		10	5955010	Chetwynd	2 980
3		10	5955014	Dawson Creek	11 125
3		10	5955030	Taylor	1 031
3		10	5955034	Fort St. John	15 021

APPENDIX 1B

Summary of Appendix 1A at the stratum/sub-stratum and cluster level
With corresponding population percentages
And first stage sampling weights

Stratum	Total pop	% pop Total(1)	Sub-stratum	Total pop	% pop Total(1)	Cluster	Total pop	% pop Total(1)	Groups (**)	First stage sampling weight
1	2601373	71.0	1	1962117	53.6				1	1
			2	300571	8.2				2	1
			3	70130	1.9				3	1
			4	81062	2.2				4	1
			5	112343	3.1				5	1
			6	75150	2.0				6	1
2	350270	9.6							7	1
3	571853	15.6				1	45796	1.3		--
						2 (*)	71125	1.9	8	2,0100281
						3	85668	2.3		--
						4 (*)	88030	2.4	9	1,6240287
						5	30035	0.8		--
						6 (*)	104875	2.9	10	1,3631776
						7	62587	1.7		--
						8 (*)	34616	0.9	11	4,1299760
						9	18070	0.5		
						10	31051	0.9		
Excluded CSD's	138463	3.8								
Total (1)	3661959									
Indian reserve	62541									
Total (2)	3724500									

(*) Clusters randomly chosen in first stage selection process of stratum 3.

(**) Refers to notation used in the selection procedure (section 4.5).

APPENDIX 2
Six tables:

Table A: The expected sample sizes for each geographic/age-sex stratum
Table B: The expected sample sizes for Spring or Fall collection (Table A 2)
Table C: The expected sample sizes for Spring or Fall REPEAT collection (Table B 3)
Table D: The corrected sample sizes for each geographic/age-sex stratum
Table E: The corrected sample sizes for Spring or Fall collection (Table D 2)
Table F: The corrected sample sizes for Spring or Fall REPEAT collection (Table E 3)

TABLE A: **The expected size for each geographic/age-sex stratum**

AGE-SEX STRATA

Str	Sub Str	Clus	Grp	M18-24	M25-34	M35-44	M45-54	M55-64	M65-74	M75-84	F18-24	F25-34	F35-44	F45-54	F55-64	F65-74	F75-84	Total
1	1		1	27	27	27	27	27	40	40	27	27	27	27	27	40	40	430
1	2		2	14	14	14	14	14	21	21	14	14	14	14	14	21	21	224
1	3		3	9	9	9	9	9	13	13	9	9	9	9	9	13	13	142
1	4		4	10	10	10	10	10	14	14	10	10	10	10	10	14	14	156
1	5		5	10	10	10	10	10	15	15	10	10	10	10	10	15	15	160
1	6		6	10	10	10	10	10	14	14	10	10	10	10	10	14	14	156
2			7	41	41	41	41	41	60	60	41	41	41	41	41	60	60	650
3		2	8	12	12	12	12	12	18	18	12	12	12	12	12	18	18	192
3		4	9	12	12	12	12	12	18	18	12	12	12	12	12	18	18	192
3		6	10	12	12	12	12	12	18	18	12	12	12	12	12	18	18	192
3		8	11	12	12	12	12	12	18	18	12	12	12	12	12	18	18	192
Total				169	169	169	169	169	249	249	169	169	169	169	169	249	249	2686

				80	80	80	80	80	117	117	80	80	80	80	80	117	117	1268
2				41	41	41	41	41	60	60	41	41	41	41	41	60	60	650
3				48	48	48	48	48	72	72	48	48	48	48	48	72	72	768
Total				169	169	169	169	169	249	249	169	169	169	169	169	249	249	2686

TABLE B: The expected sample sizes for Spring or Fall collection (Table A 2)

Numbers are rounded to the nearest integer.

AGE-SEX STRATA

	Sub str	Clus	Grp	M18-24	M25-34	M35-44	M45-54	M55-64	M65-74	M75-84	F18-24	F25-34	F35-44	F45-54	F55-64	F65-74	F75-84	Total
	1		1	14	14	14	14	14	20	20	14	14	14	14	14	20	20	220
1	2		2	7	7	7	7	7	11	11	7	7	7	7	7	11	11	114
1	3		3	5	5	5	5	5	7	7	5	5	5	5	5	7	7	78
1	4		4	5	5	5	5	5	7	7	5	5	5	5	5	7	7	78
1	5		5	5	5	5	5	5	8	8	5	5	5	5	5	8	8	82
1	6		6	5	5	5	5	5	7	7	5	5	5	5	5	7	7	78
2			7	21	21	21	21	21	30	30	21	21	21	21	21	30	30	330
3		2	8	6	6	6	6	6	9	9	6	6	6	6	6	9	9	96
3		4	9	6	6	6	6	6	9	9	6	6	6	6	6	9	9	96
3		6	10	6	6	6	6	6	9	9	6	6	6	6	6	9	9	96
3		8	11	6	6	6	6	6	9	9	6	6	6	6	6	9	9	96
Total				86	86	86	86	86	126	126	86	86	86	86	86	126	126	1364

				41	41	41	41	41	60	60	41	41	41	41	41	60	60	650
2				21	21	21	21	21	30	30	21	21	21	21	21	30	30	330
3				24	24	24	24	24	36	36	24	24	24	24	24	36	36	384
Total				86	86	86	86	86	126	126	86	86	86	86	86	126	126	1364

TABLE C: The expected sample size for Spring or Fall REPEAT collection (Table B 3)

Numbers are rounded to the nearest integer.

	Sub str	Clus	Grp	M18-24	M25-34	M35-44	M45-54	M55-64	M65-74	M75-84	F18-24	F25-34	F35-44	F45-54	F55-64	F65-74	F75-84	Total
1	1		1	5	5	5	5	5	7	7	5	5	5	5	5	7	7	78
1	2		2	2	2	2	2	2	4	4	2	2	2	2	2	4	4	36
1	3		3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	28
1	4		4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	28
1	5		5	2	2	2	2	2	3	3	2	2	2	2	2	3	3	32
1	6		6	2	2	2	2	2	2	2	2	2	2	2	2	2	2	28
2			7	7	7	7	7	7	10	10	7	7	7	7	7	10	10	110
3		2	8	2	2	2	2	2	3	3	2	2	2	2	2	3	3	32
3		4	9	2	2	2	2	2	3	3	2	2	2	2	2	3	3	32
3		6	10	2	2	2	2	2	3	3	2	2	2	2	2	3	3	32
3		8	11	2	2	2	2	2	3	3	2	2	2	2	2	3	3	32
Total				30	30	30	30	30	42	42	30	30	30	30	30	42	42	468

				15	15	15	15	15	20	20	15	15	15	15	15	20	20	230
2				7	7	7	7	7	10	10	7	7	7	7	7	10	10	110
3				8	8	8	8	8	12	12	8	8	8	8	8	12	12	128
Total				30	30	30	30	30	42	42	30	30	30	30	30	42	42	468

TABLE D: The corrected sample size for each geographic/age-sex stratum

AGE-SEX STRATA

Str	Sub str	Clus	Grp	M18-24	M25-34	M35-44	M45-54	M55-64	M65-74	M75-84	F18-24	F25-34	F35-44	F45-54	F55-64	F65-74	F75-84	Total
1	1		1	68	68	52	44	44	70	76	68	68	52	44	44	70	76	844
1	2		2	36	36	28	24	24	38	40	36	36	28	24	24	38	40	452
1	3		3	22	22	16	14	14	24	24	22	22	16	14	14	24	24	272
1	4		4	24	24	18	16	16	26	26	24	24	18	16	16	26	26	300
1	5		5	26	26	20	18	18	28	30	26	26	20	18	18	28	30	332
1	6		6	24	24	18	16	16	26	26	24	24	18	16	16	26	26	300
2			7	102	102	78	66	66	106	114	102	102	78	66	66	106	114	1268
3		2	8	32	32	24	20	20	32	34	32	32	24	20	20	32	34	388
3		4	9	32	32	24	20	20	32	34	32	32	24	20	20	32	34	388
3		6	10	32	32	24	20	20	32	34	32	32	24	20	20	32	34	388
3		8	11	32	32	24	20	20	32	34	32	32	24	20	20	32	34	388
Total				430	430	326	278	278	446	472	430	430	326	278	278	446	472	5320

				200	200	152	132	132	212	222	200	200	152	132	132	212	222	2500
2				102	102	78	66	66	106	114	102	102	78	66	66	106	114	1268
3				128	128	96	80	80	128	136	128	128	96	80	80	128	136	1552
Total				430	430	326	278	278	446	472	430	430	326	278	278	446	472	5320

TABLE E: The corrected sample sizes for Spring or Fall collection (Table D □ 2)

AGE-SEX STRATA

	Sub str	Clus	Grp	M18-24	M25-34	M35-44	M45-54	M55-64	M65-74	M75-84	F18-24	F25-34	F35-44	F45-54	F55-64	F65-74	F75-84	Total
1	1		1	34	34	26	22	22	35	38	34	34	26	22	22	35	38	422
1	2		2	18	18	14	12	12	19	20	18	18	14	12	12	19	20	226
1	3		3	11	11	8	7	7	12	12	11	11	8	7	7	12	12	136
1	4		4	12	12	9	8	8	13	13	12	12	9	8	8	13	13	150
1	5		5	13	13	10	9	9	14	15	13	13	10	9	9	14	15	166
1	6		6	12	12	9	8	8	13	13	12	12	9	8	8	13	13	150
2			7	51	51	39	33	33	53	57	51	51	39	33	33	53	57	634
3		2	8	16	16	12	10	10	16	17	16	16	12	10	10	16	17	194
3		4	9	16	16	12	10	10	16	17	16	16	12	10	10	16	17	194
3		6	10	16	16	12	10	10	16	17	16	16	12	10	10	16	17	194
3		8	11	16	16	12	10	10	16	17	16	16	12	10	10	16	17	194
Total				215	215	163	139	139	223	236	215	215	163	139	139	223	236	2660
				100	100	76	66	66	106	111	100	100	76	66	66	106	111	1250
2				51	51	39	33	33	53	57	51	51	39	33	33	53	57	634
3				64	64	48	40	40	64	68	64	64	48	40	40	64	68	776
Total				215	215	163	139	139	223	236	215	215	163	139	139	223	236	2660

TABLE F: The corrected sample size for Spring or Fall REPEAT collection (Table E 3)

Numbers are rounded to the nearest integer.

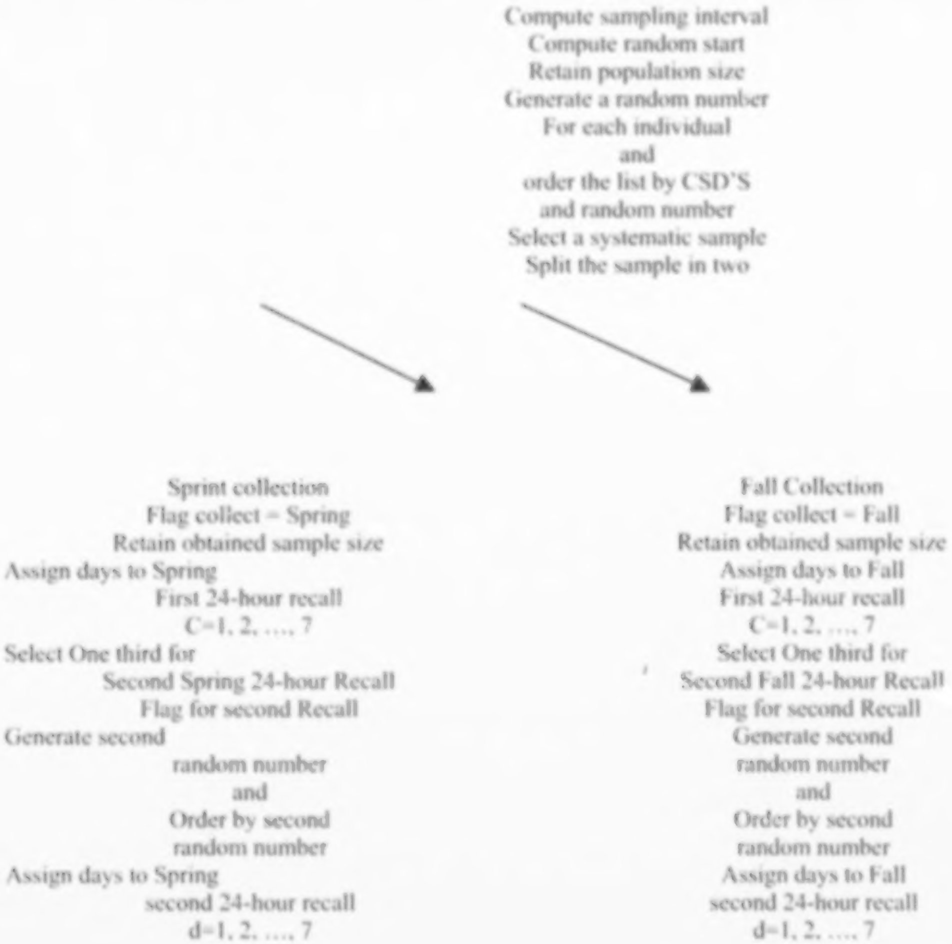
AGE-SEX STRATA

	Sub str	Clus	Grp	M18-24	M25-34	M35-44	M45-54	M55-64	M65-74	M75-84	F18-24	F25-34	F35-44	F45-54	F55-64	F65-74	F75-84	Total
1	1		1	11	11	9	7	7	12	13	11	11	9	7	7	12	13	140
1	2		2	6	6	5	4	4	6	7	6	6	5	4	4	6	7	76
1	3		3	4	4	3	2	2	4	4	4	4	3	2	2	4	4	46
1	4		4	4	4	3	3	3	4	4	4	4	3	3	3	4	4	50
1	5		5	4	4	3	3	3	5	5	4	4	3	3	3	5	5	54
1	6		6	4	4	3	3	3	4	4	4	4	3	3	3	4	4	50
2			7	17	17	13	11	11	18	19	17	17	13	11	11	18	19	212
3		2	8	5	5	4	3	3	5	6	5	5	4	3	3	5	6	62
3		4	9	5	5	4	3	3	5	6	5	5	4	3	3	5	6	62
3		6	10	5	5	4	3	3	5	6	5	5	4	3	3	5	6	62
3		8	11	5	5	4	3	3	5	6	5	5	4	3	3	5	6	62
Total				70	70	55	45	45	73	80	70	70	55	45	45	73	80	876

				33	33	26	22	22	35	37	33	33	26	22	22	35	37	416
2				17	17	13	11	11	18	19	17	17	13	11	11	18	19	212
3				20	20	16	12	12	20	24	20	20	16	12	12	20	24	248
Total				70	70	55	45	45	73	80	70	70	55	45	45	73	80	876

APPENDIX 3

Diagram of the sample selection procedure for a geographic group/age-sex combination.



Compute sampling interval
Compute random start
Retain population size
Generate a random number
For each individual
and
order the list by CSD'S
and random number
Select a systematic sample
Split the sample in two

Sprint collection
Flag collect = Spring
Retain obtained sample size
Assign days to Spring
First 24-hour recall
C=1, 2, …., 7
Select One third for
Second Spring 24-hour Recall
Flag for second Recall
Generate second
random number
and
Order by second
random number
Assign days to Spring
second 24-hour recall
d=1, 2, …., 7

Fall Collection
Flag collect = Fall
Retain obtained sample size
Assign days to Fall
First 24-hour recall
C=1, 2, …., 7
Select One third for
Second Fall 24-hour Recall
Flag for second Recall
Generate second
random number
and
Order by second
random number
Assign days to Fall
second 24-hour recall
d=1, 2, …., 7

Appendix B2

Computing Sampling Weights

Statistics Canada

British Columbia Nutrition Survey

Computing Estimation Weights

François Laflamme
Statistical Consultation Group
Statistics Canada
November 2000

1. Introduction

The British Columbia Nutrition Survey (BCNS) was conducted in 1999 along the lines of a survey design prepared by F. Bilocq[1]. The survey was relatively similar to nutrition surveys conducted in other Provinces or Territories. The main objective of the British Columbia Nutrition Survey (BCNS) was to obtain information on the dietary practices of adult aged 18 to 84. The data was collected during a face to face interview. Half of the sample was interviewed during the Spring of 1999 and the other half in the Fall of 1999. Each season, one third of the sample was re-interviewed in order to measure intra-personal variation of food intake.

2. Target population

The target population for the BCNS was the set of all residents aged 18 to 84, living in British Columbia at the time of the survey, excluding those on Indian Reserves, military camps and institutions. Furthermore, pregnant women and lactating women were excluded from the survey when identified by the nurses during the interview. A set of remote areas (based on 1996 Census sub-division CSD's) were identified by the Client. These remote areas are excluded from data collection but are still part of the population under study. This will be taken into account when post-stratification is performed. Once Indian Reserves are excluded the remote areas account for 3.8% of the population.

3. Sample Design

The design used for BCNS is a stratified multi-stage sampling design. Firstly, the three following strata were created from a list of in-scope CSD's according to the client's specifications: Metro, Coastal and Non-Metro Interior. In addition, the Metro stratum was further divided into 6 sub-strata (see Appendix I). Finally, the non-metro interior stratum was split into 10 clusters in order to reduce the cost of travel associated with data collection. To simply the notation, sub-strata, stratum 2 and clusters could be referred as geographic groups. Then, strata 1 has 6 geographic groups (sub-strata 1 to 6), strata 2 has one geographic group while strata 3 has 10 geographic groups (clusters).

At the first stage, the 7 geographic groups of stratum 1 and 2 were chosen with certainty (probability=1) while a sample of 4 geographic groups (clusters) was randomly selected in stratum 3 with probability proportional to the population size of the groups. The population of the 11 geographic groups was further stratified in 14 age-sex strata: Male/Female, 18-24/25-34/35-44/45-54/55-64/65-74/75-84.

At the second stage, the client selected from the British Columbia Health Register (BCHR), a sample of individuals within 11geographic groups according to the sample allocation to each stratum-geographic group- age- sex combination. This second stage sampling frame comprises the in-scope individuals of the BCHR who are aged (or will be aged) 18 to 84 at the time of the Spring collection and lives in the CSD's identified for these defined stratum. For more detailed information about the sample design, see Bilocq (1999).

It should be noted that while the survey was conducted in 1999, the stratification and sampling of primary units was done using 1996 data. Of course, sampling of individual respondents was done using current information. The time lag between the base data and the field work may cause some coverage bias in the estimates (i.e. representing the 1996 population rather than that of 1999); some corrective measure should be taken at estimation.

---

[1] Bilocq, F. "British Columbia Nutrition Survey – Sample Design Specifications", Statistics Canada, Social Survey Methods Division, March 1999

4. Notation

The following notation will be used below

Symbol	Meaning
H	Stratum level, h=1, 2, 3
a	Geographic groups; a=1 to 6 for sub-strata 1 to 6, a=1 for stratum 2 and a= 1 to 10 for clusters of the third stratum.
i	Age sex group, i=1, 2,..., 7 for male; i=8, ..., 14 for female
M_{ha}	Number of individuals in strata "h" and geographic group "a" - 1996 census
M_h	Total number of individuals in BC in strata "h" – 1996 census
m_h	Number of geographic group sampled in strata "h"
$_{ha}$	First-stage weight, list given in Appendix II
y_{haik}	Value of characteristic "Y" for individual "k" in strata "h", geographic group "a" and age-sex group "i"
N_{hai}	Number of individuals at the time of sample selection in strata "h", geographic group "a" and age-sex group "i" on BCHR at the time of sample selection
n_{hai}	Number of individuals ultimately sampled in strata "h", geographic group "a" and age-sex group "i" (i.e. all used replicates)
r_{hai}	Number of responses from age-sex "i" in strata "h" and geographic group "a"
w^*_{hai}	Unadjusted sampling weight for strata "h", geographic group "a" and age-sex group "i"
	Estimated size for age-sex group "i"
P_i	Post census estimated count for BC, age-sex group "i", for 1999 (see Appendix III)
w_{hai}	Age-sex adjusted (i.e. post-stratified) estimation weights in strata "h", geographic group "a" and age-sex group "i"

5. Computing Estimation Weights

With these notations,

$$\alpha_{ha} = \begin{cases} 1, \text{if h} = 1 \text{ or } 2 \\ \dfrac{M_h}{M_{ha} \times m_h}, \text{if h} = 3 \end{cases}$$

and

$$w^{*}_{hai} = \alpha_{ha} \times \frac{N_{hai}}{n_{hai}} \times \frac{n_{hai}}{r_{hai}}, \text{ for all h, a, i}$$

Now, one can readily obtain an estimate for the age-sex group size by computing for each age-sex group "i":

$$\hat{P}_i = \sum_{hak} w^{*}_{hai} = \sum_{ha} r_{hai} w^{*}_{hai} = \sum_{ha} \alpha_{ha} N_{hai}$$

then the age-sex adjusted (i.e. post-stratified) weights are given by:

$$w_{hai} = w^{*}_{hai} \times \frac{P_i}{\hat{P}_i}$$

An EXCEL worksheet was prepared for the purpose of computing adjusted estimation weights.

Cautionary Note on Estimating Sampling Error

Every survey estimate is accompanied by some amount of uncertainty called "sampling error". This error can be estimated directly from the sample, as long as the particularities of the survey design are dealt correctly. Given the design of BCNS (likely clustering in the data), it is not wise to use general-purpose software (Excel, SPSS…) to compute sampling errors; analysts should realise that failing to account for the design might seriously underestimate the sampling error. With a design as that of BCNS, it is often recommended to use specialised software to compute sampling errors such as SUDAAN, PC-CARP, WesVarPC, GES or JackVar.

Appendix I: Strata used in British Columbia Nutrition Survey

Stratum 1: Metro

- Sub-stratum 1: Vancouver
- Sub-stratum 2: Victoria
- Sub-stratum 3: Nanaimo
- Sub-stratum 4: Kamloops
- Sub-stratum 5: Kelowna
- Sub-stratum 6: Prince Georges

Stratum 2: Coastal

Stratum 3: Non-metro interior

The list of in-scope CSD's for stratum 1 (sub-strata 1 to 6), stratum 2 and stratum 3 (clusters 1 to 10) was provided in Bilocq[2].

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[2] Bilocq, F. "British Columbia Nutrition Survey – Sample Design Specifications", Statistics Canada, Social Survey Methods Division, March 1999

APPENDIX II: First-stage weights by Stratum and Geographic Groups, British Columbia Nutrition survey.

Stratum	Sub-stratum	Cluster	Geographic Groups (**)	First stage sampling weight
1	1		1	1
	2		2	1
	3		3	1
	4		4	1
	5		5	1
	6		6	1
2			1	1
3		2 (*)	2*	2,0100281
		4 (*)	4*	1,6240287
		6 (*)	6*	1,3631776
		8 (*)	8*	4,1299760
Number of selected Geographic Groups			11	

APPENDIX III: 1999 Post Census Estimated counts, British Columbia, by Sex and Age Group.

Appendix B

24-Hour Recall Form

Identifier # ☐☐☐☐☐

BRITISH COLUMBIA NUTRITION SURVEY – 24 HOUR RECALL (Fall Season) FORM B

Interviewer ID ☐☐ Facilitator ID ☐☐ Start Time: __ __ : __ __ End Time: __ __ : __ __ *of Recall*

Time 00:01 23:59	Rest/ Cafe *	Meal/ Snack **	Home Prep. ***	FOOD DESCRIPTION	Salt	# of Portions	Model	Thick-ness

*Restaurant / Cafeteria
C=cafeteria
F=fast food
R=restaurant (table service)
T=take-out outlet, deli
V=vending machine, snack bar

**Meal/Snack
BK=breakfast
L=lunch
D=dinner
BC=brunch
S=snack

***Homemade
H=homemade baked products made from scratch or a mix in your own home
E=homemade baked products made from scratch or mix elsewhere than in your own home

Did you prepare most of the foods you ate yesterday? ☐Yes ☐No

For interviewers only:
In the interview, was the respondent assisted by the person who prepared the meals? ☐Yes ☐No ☐N/A
Did the respondent have prior knowledge that a 24 hour recall would be taken? ☐Yes ☐No

NUTRIENT SUPPLEMENT FORM

1. Yesterday, did you take any of the following: nutritional supplements, vitamins, minerals, or herbal, botanical or homeopathic preparations? **Y / N**
2. In the last month, did you take any other nutritional supplements, vitamins, minerals or herbal, botanical or homeopathic preparations? **Y / N**
3. Please tell me the name of all these products with their DIN (when available) that you took yesterday or during the last month. (DIN is a Drug Id. #)
4. Yesterday, at what time did you take your supplements and how many pills (or tablets, capsules, teaspoons, etc.) were taken at each time?
5. In the last month, how often was each of these supplements taken? (Number of times per day, per week or per month)
6. How many pills (or tablets, capsules, teaspoons, etc.) were usually taken on each occasion?

SUPPLEMENT NAME	DIN	YESTERDAY		DURING THE LAST MONTH			
				HOW OFTEN			HOW MUCH
		AT WHAT TIME?	#PILLS, TABS, CAPS, TSP...	DAY	WEEK	MONTH	#PILLS, TABS, CAPS, TSP...

RECIPE FORM # 1

Name of Recipe: ______________________

Cooking Time: ____________

Temperature: ____________

DESCRIPTION OF THE RECIPE AND COOKING PROCEDURES	QUANTITY

TOTAL YIELD: __________

RECIPE FORM # 2

Name of Recipe: ______________________

Cooking Time: ____________

Temperature: ____________

DESCRIPTION OF THE RECIPE AND COOKING PROCEDURES	QUANTITY

TOTAL YIELD: __________

Appendix C

Food Frequency Questionnaire

Identifier # | | | | |

B.C. FOOD FREQUENCY QUESTIONNAIRE (Fall Session) FORM C

PART I

The next part of the survey is a list of foods that we are interested in knowing whether you ate the food or not over the last month. If you did eat them, we would like to know how often you ate them and how much you ate at any one time. We are interested only in whether you have eaten them in the last month. So, if you have not eaten those foods at least once within the past month (that is before...give the date of one month ago) they are not important to this part of the survey. We will be looking at usual portions of these foods unlike the exact amounts eaten in the "yesterday" part of the survey.

"Please think about the last 4 weeks. Were they work weeks or holiday times? Did they involve a special occasion such as a wedding or party?

"Now I am going to read the list of foods"

"In the past month did you eat _______?"

IF NO, MOVE TO NEXT FOOD.
IF YES, THEN GO TO DAILY.

DAILY

"Did you eat __________ everyday in the past 4 weeks?

IF NO, MOVE TO WEEKLY
IF YES, THEN ASK "How many times a day." Using this model as a guide, would your usual serving size be the same, more, or less. How much more, how much less?"

WEEKLY

Did you eat ________ every week in the past month?

IF NO, MOVE TO MONTHLY
IF YES, THEN ASK "How many times a week?" Using this model as a guide, would your usual serving size be the same, more, or less. How much more, how much less?

MONTHLY

Then, how many times over the past month have you eaten ________? Using this model as a guide, would your usual serving size be the same, more, or less. How much more, how much less?

PLEASE NOTE - Respondents aged 75-84 (age/gender group 7 and 14) will not be asked about the portion section of the FFQ.

Identifier # ☐☐☐☐☐

FOOD	FREQUENCY			PORTION SIZE		COMMENTS
	FURTHER FOOD DESCRIPTIONS	#	DAY/D WEEK/W MONTH/M	REFERENCE PORTION SIZE OR MODEL	HOW MUCH/ HOW MANY?	
HOW OFTEN DID YOU CONSUME: **Vegetables and Fruits** 01 Broccoli				1 MO-M		
02 Cabbage, coleslaw, sauerkraut				1 MO-M		
03 Carrots or mixed vegetables and carrots				1 MO-M		
04 Dark leafy greens – cooked				1 MO-M		
05 Dark leafy greens – raw				1 MO-M		
06 Squash (dark yellow)				1 MO-M		
07 Potatoes – French fries or panfried				1 MO-L		
08 Potatoes - baked, mashed or boiled				1 MO-L		
09-13 foods withdrawn for the fall session						

Identifier # ☐☐☐☐☐

FOOD	FREQUENCY			PORTION SIZE		COMMENTS
	FURTHER FOOD DESCRIPTIONS	#	DAY/D WEEK/W MONTH/M	REFERENCE PORTION SIZE OR MODEL	HOW MUCH/ HOW MANY?	
Meat, Poultry, Fish and Alternatives 14 Poultry – fried				PC-S		
15 Poultry - cooked other ways				PC-S		
16 Beef - steaks, roasts, stews, and other cuts				PC-S		
17 Beef – hamburgers				PC-S		
18 Beef - other ground beef				PC-S		
19 Pork and Ham - roasts, chops and other cuts				PC-S		
20 Pork – bacon				1 STRIP		
21 Liver				PC-S		
22 Fish - fried (excl. shellfish)				PC-S		

Identifier # ☐☐☐☐☐

FOOD	FREQUENCY			PORTION SIZE		COMMENTS
	FURTHER FOOD DESCRIPTIONS	#	DAY/D WEEK/W MONTH/M	REFERENCE PORTION SIZE OR MODEL	HOW MUCH/ HOW MANY?	
23 Fish – cooked in other ways (excl. shellfish)				PC-S		
24 Wieners or Sausages (with or without a bun)				1 UNIT		
25 Luncheon meats (cold cuts)				1 SLICE		
26 Eggs or egg dishes				1 EGG		
Milk Products 27 Cheese - regular, hard cheeses (>25 % MF)				1 SLICE or 1/3 PC-S		
28 Cheese - lower or reduced fat, part skim, processed or spreadable (10 - 24% MF)				1 SLICE or 1/3 PC-S or 2 TBL		
29 Cottage or ricotta cheeses				MO-S		
30 Yoghurt - all types				½ CUP or 175 G		
31 Ice Cream – regular or rich				½ CUP		

Identifier # ☐☐☐☐☐

FOOD	FREQUENCY			PORTION SIZE		COMMENTS
	FURTHER FOOD DESCRIPTIONS	#	DAY/D WEEK/W MONTH/M	REFERENCE PORTION SIZE OR MODEL	HOW MUCH/ HOW MANY?	
32 Ice Cream - low fat, frozen yoghurt, jce milk or sherbet				½ CUP		
Grain Products 33 Cookies				1 COOKIE		
34 Crackers				1 CRACKER		
35 Donuts, cakes, pies, muffins, croissants				1 UNIT		
Other Foods 36 Potato or tortilla chips				1 BO-L		
37 Pizza				1 SLICE		
38 Rich gravy or pan drippings				1/4 CUP		
39 Cream or cheese sauce				1/4 CUP		

Identifier # ☐☐☐☐☐

FOOD	FREQUENCY			PORTION SIZE		COMMENTS
	FURTHER FOOD DESCRIPTIONS	#	DAY/D WEEK/W MONTH/M	REFERENCE PORTION SIZE OR MODEL	HOW MUCH/ HOW MANY?	
Alcohol 40 Beer				1 BOTTLE		
41 Wine				4 F OZ		
42 Coolers/Ciders				1 BOTTLE		
43 Spirits				1 F OZ		
What kind of milk did you use in: (*Do not read list. See codes below.*) 44 Tea or Coffee				1 TBL		
45 On Cereal				½ CUP		
46 As a Beverage (white or chocolate)				1 CUP		

Select the types of milk consumed using the appropriate letter(s):

A Whole milk	G Cream or creamers
B 2% milk	H Evaporated milk, regular (whole), NON diluted
C 1% milk	I Evaporated milk, light, NON diluted
D Buttermilk	J Evaporated milk, 2%, NON diluted
E Skim milk	K Evaporated milk, skim, NON diluted
F Dry skim milk powder	L Evaporated milk, regular (whole), DILUTED

Identifier #

M Evaporated milk, light, DILUTED
N Evaporated milk, 2%, DILUTED
O Soy beverage
P Fortified soy beverage
Q Rice milk
R Fortified rice milk
S Other types of milk such as goat milk, etc.
(Please specify)
T Used coffee whitener
U Did not add milk or cream to tea or coffee
V Ate cereals dry

Identifier # ☐☐☐☐☐

For respondents aged 75-84 (age/sex group 7 and 14) go to PART IV, pg 11

PART II

This section deals with homemade foods and your use of fat over the past month. (*Do NOT read list. Check (✓) the main source(s) of fat used. If more than one source is checked, then all responses will be calculated as equal proportions.*)

IF YOU ATE HOME DEEP-FAT-FRIED FOODS AT LEAST TWICE THIS PAST MONTH, WHAT WAS THE MAIN KIND OF FAT OR OIL USED? (*Do NOT read list.*)		
47		Vegetable oil
48		Lard, bacon fat or other animal fat
49		Shortening
50		Do not know
51		Did not eat home deep-fried foods this past month
IF YOU ATE HOME-PAN FRIED FOODS AT LEAST TWICE THIS PAST MONTH, WHAT WAS THE MAIN KIND OF FAT OR OIL USED? (*Do NOT read list.*)		
52		Butter
53		Soft margarine
54		Hard margarine
55		Lard, bacon or other animal fat
56		Shortening
57		Vegetable oil
58		Pam or no oil
59		Do not know
60		Did not eat home pan-fried foods this past month
IF YOU ATE HOME-BAKED FOODS AT LEAST TWICE THIS PAST MONTH, WHAT WAS THE MAIN KIND OF FAT OR OIL USED? (*Do NOT read list.*)		
61		Butter
62		Soft margarine
63		Hard margarine
64		Shortening
65		Vegetable oil
66		Lard, bacon or other animal fat
67		Do not know
68		Did not eat home-made baked goods that contained fat this past month

Identifier # ☐☐☐☐☐

WHAT WAS THE MAIN KIND OF "FAT SPREAD" YOU USED ON BREAD, BUNS, MUFFINS, ETC. THIS PAST MONTH? (*Do NOT read list.*)		
69		Butter
70		Soft margarine
71		Hard margarine
72		Low calorie margarine
73		Lard, bacon or other animal fat
74		None or none of these
75		Did not eat bread, buns, muffins, etc. this past month
WHAT WAS THE MAIN KIND OF "FAT SPREAD" YOU PUT ON POTATOES OR VEGETABLES THIS PAST MONTH? (*Do NOT read list.*)		
76		Butter
77		Soft margarine
78		Hard margarine
79		Low calorie margarine
80		Sour cream
81		Lard, bacon fat, other
82		None or none of these
83		Did not eat potatoes and vegetables this past month

Identifier # ☐☐☐☐☐

PART III **This section deals with your food habits during the past month.**

(Do NOT read list. Check (✓) all that apply. If the person did not eat meat or poultry or fish in Part I, then check (✓) "Did not eat meat/poultry/fish cooked by these methods this past month" below where appropriate.)

OF THE MEAT YOU ATE LAST MONTH, WHAT WAS THE MOST COMMON METHOD OF COOKING IT? *(Do NOT read list.)*		
84		Broiled
85		Pan-fried with fat
86		Pan-fried without fat or with pan spray
87		Deep-fat fried
88		Oven-roasted (Baked)
89		Boiled
90		Microwaved
91		Barbecued
92		Steamed/Poached
93		Other method, specify:
94		Did not eat meat this past month
OF THE POULTRY YOU ATE LAST MONTH, WHAT WAS THE MOST COMMON METHOD OF COOKING IT? *(Do NOT read list.)*		
95		Broiled
96		Pan-fried with fat
97		Pan-fried without fat or with pan spray
98		Deep-fat fried
99		Oven-roasted (Baked)
100		Boiled
101		Microwaved
102		Barbecued
103		Steamed/Poached
104		Other method, specify:
105		Did not eat poultry this past month
OF THE FISH YOU ATE LAST MONTH, WHAT WAS THE MOST COMMON METHOD OF COOKING IT? *(Do NOT read list.)*		
106		Broiled
107		Pan-fried with fat
108		Pan-fried without fat or with pan spray
109		Deep-fat fried
110		Oven-roasted (Baked)
111		Boiled
112		Microwaved
113		Barbecued
114		Steamed/Poached
115		Other method, specify:
116		Did not eat fish this past month

Identifier # | | | | | |

If the person did not eat meat or poultry in Part I, then check (✓) "Did not eat meat/poultry this past month" below where appropriate.

OF THE MEAT YOU ATE LAST MONTH, DID YOU EAT THE VISIBLE FAT OF THE MEAT?		
117		Always
118		Sometimes
119		Never
120		Did not eat meat this past month
OF THE POULTRY YOU ATE LAST MONTH, DID YOU EAT THE SKIN OF THE POULTRY?		
121		Always
122		Sometimes
123		Never
124		Did not eat poultry this past month
IN THE PAST MONTH, WHAT WAS THE MAIN KIND OF DRESSING YOU ADDED TO YOUR SALADS? *(Do NOT read list.)*		
125		Mayonnaise
126		Mayonnaise-type and regular salad dressing
127		Low calorie and calorie-reduced salad dressing
128		Homemade oil and vinegar dressing
129		Other
130		Did not add salad dressing
131		Did not eat salad this past month

Identifier # ☐☐☐☐☐

PART IV **This section deals with why you choose the foods that you eat.**

Next, we would like to know if you have specific reasons for choosing the foods that you eat. I have here a list of health related items which I will read out to you. Answer "yes" only to those reasons that really affect the choices you make in foods....what you eat or what you don't eat. *(Read the lists. Check (✓) all that apply. Briefly probe to confirm some action is being taken. Enter a "0" if not applicable.)*

ARE YOU CHOOSING OR AVOIDING FOODS OR TYPES OF FOODS BECAUSE YOU ARE CONCERNED ABOUT: *(Read list.)*		
132		Maintaining and improving your health?
133		Heart Disease?
134		Cancer?
135		Osteoporosis (brittle bones)?
136		High blood pressure?
137		Weight gain?
138		Food Allergies or Intolerances?
139		None of the above
ARE YOU CHOOSING TO EAT FOODS OR TYPES OF FOODS BECAUSE OF: *(Read list.)*		
140		The nutrients they contain?
141		The type of fat they contain?
142		The unsaturated fat content?
143		The fibre content?
144		None of the above
ARE YOU AVOIDING FOODS OR TYPES OF FOODS BECAUSE OF: *(Read list.)*		
145		The fat content?
146		The salt content?
147		The cholesterol content?
148		The sugar content?
149		The saturated fat content?
150		None of the above

1. Do you consider yourself a vegetarian?

☐ Yes
☐ No → **go to question 2**

1a. Do you ever eat:

Dairy Products	☐ Yes	☐ No
Eggs	☐ Yes	☐ No
Fish/Seafood	☐ Yes	☐ No
Poultry	☐ Yes	☐ No
Red meat	☐ Yes	☐ No

Identifier # ☐☐☐☐☐

2. I'm going to read you a list of conditions. Please indicate if you have this condition or if you have had this condition in the past. (*Read list. Check (✓) all that apply.*)

☐ Diabetes (*Read* - **does NOT include high blood sugars during pregnancy**)
☐ Heart Disease
☐ Stroke
☐ High Blood Pressure (*Read* - **does NOT include high blood pressure during pregnancy**)
☐ High Cholesterol
☐ Cancer
☐ Osteoporosis
☐ None of the above

3. Are you following any special diet?

☐ Yes (specify ____)
☐ No → **go to question 4**

3a. Who prescribed this special diet?

☐ Doctor
☐ Dietitian
☐ Naturopath
☐ Chiropractor
☐ Self-prescribed
☐ Relative / Friend (not a doctor, dietitian, naturopath or chiropractor)
☐ Other (specify ________________________________)
☐ Don't know
☐ Refused

4. In the past month, how many servings of fruits and vegetables did you eat on average every day? (*One serving is equal to ½ cup juice or ½ cup fresh / canned / frozen fruit and vegetable, or 1 medium whole fruit or 1 cup green salad.*)

☐☐ Record #

If the respondent has a second interview assigned, then go to FORM D (the Nutrition, Activity and Health Questionnaire), question 1. Otherwise, continue with question 5a on the next page.

Identifier # ☐☐☐☐☐

5a. Have you ever seen or heard about the Canada's Food Guide to Healthy Eating? (*Show Food Guide.*)

☐ Yes
☐ No → **go to next questionnaire**

5b. Do you use it?

☐ Yes
☐ No → **go to next questionnaire**

5c. How do you use it? (*Do not read. Check (✓) all that apply.*)

☐ For shopping (eg. to prepare my shopping list)
☐ For planning/choosing meals (at home)
☐ For choosing foods in restaurants
☐ Other (specify ____)

Appendix D

Nutrition, Activity and Health Questionnaire

Identifier # ☐☐☐☐☐

B.C. NUTRITION, ACTIVITY AND HEALTH QUESTIONNAIRE FORM D

In the event you find any of the questions sensitive to you, please let me know and we can move on to the next question.

The next questions are about your physical activity and weight.

1. Considering a week in the past month, how many times on the average did you do the following kinds of physical activities for more than 15 minutes during your leisure time? (*Show card with examples listed for part a, b and c. Write in each box the appropriate number of times per week.*)

   a. **STRENUOUS EXERCISE** (heart beats rapidly) such as running, jogging, hockey, football, soccer, squash, basketball, cross-country skiing, judo, roller skating, vigorous swimming, vigorous long distance bicycling, singles tennis, intense weight training, high-impact aerobic exercises.

   # times per week ☐☐

   b. **MODERATE EXERCISE** (not exhausting) such as fast walking, baseball, doubles tennis, easy bicycling, volleyball, badminton, easy swimming, down hill skiing, popular and folk dancing, callisthenics, weight training for toning muscles, low-impact aerobic exercises, curling (sweeper).

   # times per week ☐☐

   c. **MILD EXERCISE** (minimal effort) such as yoga, archery, fishing from river bank, bowling, horseshoes, golf, snowmobiling, easy walking, curling (other than sweeper), gardening, housework (vacuuming, sweeping).

   # times per week ☐☐

2. How do you describe your work? By work we mean paid work and non-paid work such as a homemaker. Which of the following best describes how you spend most of your work time. (*Show card. Check (✓) only one. If the person is retired or unemployed, check not applicable. If a person does volunteer work for 20 hours or more per week, this can be considered unpaid work.*)

   - ☐ My work is mainly sitting. I do not walk much during work, e.g. telephone operator, computer programmer.
   - ☐ In my work I walk or move quite a lot but I do not have to lift or carry heavy things, e.g. shop assistant, light housework.
   - ☐ In my work I have to walk and carry a lot or climb staircases often or go uphill, e.g. carpentry, farm work, heavy housework.
   - ☐ My work is heavy physical labour where I usually have to carry, lift heavy things, dig or shovel, e.g. forestry work, heavy farm work, warehouse work.
   - ☐ Not applicable (ie. retired, unemployed, other (specify: ____________________)

Identifier # | | | | | |

3. Would you consider yourself overweight, underweight or just about right?

☐ Overweight ➔ Would you consider yourself:
- ☐ Very overweight
- ☐ Somewhat overweight
- ☐ A little overweight

☐ Underweight ➔ Would you consider yourself:
- ☐ Very underweight
- ☐ Somewhat underweight
- ☐ A little underweight

☐ Just About Right

4. Are you presently trying to change your weight?

☐ Yes ➔➔➔ Are you trying to lose or gain weight?

☐ No ↬ **go to Q 7**

☐ Not sure ↬ **go to Q 7**

☐ Lose ➔➔

☐ Not Sure ↬ **go to Q 7**

☐ Gain ➔➔

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How much?

☐☐☐.☐ Kg

or

☐☐☐.☐ Lbs

❑ Not sure

↪ go to Q 5

How much?

☐☐☐.☐ Kg

or

☐☐☐.☐ Lbs

❑ Not sure

↪ go to Q 6

Identifier # ☐☐☐☐☐

5. What are you currently doing to lose weight? (*Do NOT read out responses. Check (✓) all that apply. After each verbal response, ask, "Is there anything else you are doing?"*)

☐ Changing eating habits (such as reducing portions, eating less fat)
☐ Exercising more
☐ Following a specific diet plan
☐ Skipping meals
☐ Taking diet pills
☐ Taking meal replacements/supplements (specify ______________________)
☐ Attending a weight control program
☐ Receiving dietary counselling with registered dietitian/nutritionist
☐ Receiving dietary counselling (other, specify__________________________)
☐ Other (specify____)

↬ GO TO QUESTION 7a

6. What are you currently doing to gain weight? (*Do NOT read responses. Check (✓) all that apply. After each verbal response, ask, "Is there anything else you are doing?"*)

☐ Changing eating habits (such as increasing portions, eating more frequently, eating higher calorie foods)
☐ Exercising more
☐ Restricting exercise
☐ Following a specific diet plan
☐ Taking meal replacements/supplements (specify______________________)
☐ Receiving dietary counselling with registered dietitian/nutritionist
☐ Receiving dietary counselling (other, specify_________________________)
☐ Other (specify____)

7a. The next question addresses your exercise habits and is based upon the following definition of exercise. (*Show card. Read definition.*)

Exercise includes activities such as swimming, aerobic dancing, biking, rowing, jogging, brisk walking, etc. Activities that are primarily sedentary, such as bowling, or playing golf with a cart, would not be considered exercise. (*Ask the respondent if he/she understands the definition. Repeat the definition if necessary.*)

Considering this definition, please listen to the following statements and answer yes or no. (*Check (✓) the response*)

I currently exercise.

☐ Yes **↬ go to question 7c**
☐ No

7b. I intend to exercise in the next 6 months.

☐ Yes **↬ go to question 8**
☐ No **↬ go to question 8**

Identifier # ☐☐☐☐☐

7c. I'm going to read you a definition of ***REGULAR*** exercise to consider for the next statement. ***REGULAR*** exercise is equal to 3 times or more per week for 20 minutes or longer each time. (*Show card. Read definition. Ask the respondent if he/she understands the definition. Repeat the definition if necessary.*)

I currently exercise ***REGULARLY***.

☐ Yes ↬ **go to question 7d**
☐ No ↬ **go to question 8**

7d. I have been exercising ***REGULARLY*** for the past 6 months.

☐ Yes
☐ No

The next set of questions are about your weight and the way you feel about your body.

8. On a scale of 1-5, where 1 is very uncomfortable and 5 is very comfortable, how comfortable do you feel about your body when you see yourself in a mirror? (*Show card. Circle answer.*)

1	2	3	4	5	
Very Uncomfortable	Somewhat Uncomfortable	Neutral (neither comfortable nor uncomfortable)	Somewhat Comfortable	Very Comfortable	Not Sure

9. First, I'm going to read out some statements. please state whether the statement is true (T) or false (F) for you. (*If respondent cannot decide whether a statement is true or false for them, ask them to identify whether it is true or false most of the time*)

I. I do not eat some foods because they make me fat.......... T F

ii. When I feel 'down' or sad, I often overeat.......... T F

iii. I deliberately take small helpings as a means of controlling my weight.......... T F

iv. Sometimes when I start eating, I just can't seem to stop.......... T F

v. When I feel lonely, I console myself by eating.......... T F

10. For the next set of questions, I'm going to ask you to indicate which response best describes your eating behaviour.

i. How often are you restricting your food intake in a conscious effort to control your weight. Would you say you do this:

1	2	3	4
Rarely	Sometimes	Usually	Always

Identifier #

10. (continued)

ii. Do you go on eating binges even though you are not hungry? Would you say you do this: (***Only*** *if asked to define binge, read the following definition: A binge means eating a very large amount of food in a very short period of time, and feeling that you can't control how much you're eating.*)

1	2	3	4
Never	Rarely	Sometimes	At least weekly

iii. How likely are you to consciously eat less than you want. Would you say you are:

1	2	3	4
Unlikely	Slightly likely	Moderately likely	Very likely

iv. On a scale of 0-5, where 0 means no restraint in eating (eating whatever you want, whenever you want), and 5 means total restraint (constantly limiting food intake and never 'giving in'), how would you rate yourself? (*Show card. Circle response*).

0	1	2	3	4	5
eat whatever you want, whenever you want	usually eat whatever you want, whenever you want	often eat whatever you want, whenever you want	often limit food intake, but often 'give in'	usually limit food intake, rarely 'give in'	constantly limit food intake, never 'give in'

11a. The next question is about your lifestyle physical activity which is a bit different from exercise. (*Show card. Read definition.*)

Lifestyle physical activity means walking leisurely, vacuuming, digging in the garden, climbing stairs or any other physical activity where the exertion is similar to these. (*Ask respondent if he/she understand the definition. Repeat the definition if necessary.*)

Considering this definition, please listen to the following statements and answer yes or no. (*Check (✓) the response*)

I am currently physically active.

☐ Yes ➥ **go to question 11c**
☐ No

11b. I intend to become physically active in the next 6 months.

☐ Yes ➥ **go to question 12**
☐ No ➥ **go to question 12**

Identifier # ☐☐☐☐☐

11c. I'm going to read you a definition of ***REGULAR*** lifestyle physical activity to consider for the next statement. ***REGULAR*** lifestyle physical activity means accumulating 30 minutes or more in the above activities per day for at least 4 days per week. For example, you could take one 30 minute walk, jog, bike or swim or three 10 minute walks or 15 minutes of vacuuming plus 10 minutes of digging plus 5 minutes of climbing stairs. Listen to the following statement and answer yes or no. (*Show card. Read definition and example. Ask the respondent if he/she understands the definition and example. Repeat if necessary.*)

I am ***REGULARLY*** physically active.

☐ Yes
☐ No ↪ **go to question 12**

11d. I have been ***REGULARLY*** physically active for the past 6 months.

☐ Yes
☐ No

12. What prevents you from being more physically active (*This includes both lifestyle physical activity and exercise. Do NOT read list. Check (✓) all that apply. Use prompt, "Anything else?" after each response.*)

☐ I am active enough already
☐ Illness or disability
☐ Lack of time
☐ Lack of transportation
☐ Lack of money
☐ Lack of easily accessible facilities
☐ Lack of interesting or relevant activities
☐ Lack of motivation or will power
☐ Other interests or priorities
☐ Other commitments such as children, family, school or work
☐ Weather
☐ Too tired / no energy
☐ No one to exercise with
☐ Other (specify ____________________________________)
☐ None of the above

Identifier #

The following questions are about your dental health and practices.

13. Adults can have up to 32 natural teeth but over time people lose some of them. How many natural teeth, including crowns do you have? (*Read response categories.*)

- ☐ 20 or more natural teeth
- ☐ between 10 and 19 teeth
- ☐ between 1 and 10 natural teeth
- ☐ no natural teeth

14. Currently, do your gums bleed when you eat or brush your teeth?

- ☐ Yes
- ☐ No

15. Currently, do you have any problems or difficulties biting or chewing your food?

- ☐ Yes
- ☐ No

16. Which of the following do you do daily? (*Read response categories. Check (✓) all that apply.*)

- ☐ Clean my teeth with a toothbrush
- ☐ Use a toothpaste containing fluoride
- ☐ Use dental floss
- ☐ Use a mouth rinse
- ☐ Restrict my intake of sugar to prevent dental decay
- ☐ None of the above

17. Do you wear partial or full dentures?

- ☐ Yes →→→
- ☐ No ↪ **go to question 19**

Which of the following do you do daily? (*Read response categories. Check (✓) all that apply.*)

- ☐ Clean my dentures
- ☐ Leave my dentures out at night
- ☐ Neither of the above

18. About how long ago was your last visit to the dentist? (*Read response categories. Check (✓) one.*)

- ☐ less than 1 year
- ☐ more than 1 year, up to 2 years ago
- ☐ more than 2 years, up to 5 years ago
- ☐ more than 5 years
- ☐ never been to the dentist

Identifier # ☐☐☐☐☐

The following questions are about food handling practices in your home. If you are not the person who prepares food in your home, answer the questions according to what is usually done in your home.

19. How do you usually cook hamburgers for yourself? (*Show card. Read response categories.*)

☐ Rare (pink in the middle)
☐ Medium (brown throughout with a little pink in the middle)
☐ Well done (no pink, juices running clear)
☐ Don't know
☐ Don't serve hamburgers

20. Having cooked a large casserole with meat in it for the next day, how do you usually cool it? (*Show card. Read response categories. If the person does not eat meat, substitute poultry or fish in the question.*)

☐ Leave it on the stove/counter for more than 2 hours before putting it in the refrigerator
☐ Leave it on the stove/counter for up to 2 hours before putting it in the refrigerator
☐ Put it in the refrigerator immediately after cooking
☐ Separate it immediately into smaller portions and placing them into the refrigerator
☐ None of the above
☐ Don't know
☐ Don't cook casseroles with meat in it for the next day

21. Between handling with your bare hands raw poultry and a salad, what do you usually do? (*Show card. Read response categories. If the person does not eat poultry, substitute fish or meat in the question.*)

☐ Rinse your hands
☐ Wash your hands with soap and water
☐ Wipe your hands only
☐ None of the above
☐ Don't know
☐ Don't handle raw poultry / Don't handle with bare hands

22. Having used a dish cloth to wipe up after cutting raw fish, what do you usually do? (*Show card. Read response categories. If the person does not eat fish, substitute meat or poultry in the question.*)

☐ Discard the dish cloth, including paper towel
☐ Set the dish cloth aside until needed again
☐ Rinse out the dish cloth in water before using again
☐ Put the dish cloth in the laundry
☐ Wash the dish cloth in soap and water before using again
☐ Sterilize the dish cloth with very hot water, or sanitiser (eg. chlorine solution)
☐ None of the above
☐ Don't know
☐ Don't cut raw fish

Identifier # ☐☐☐☐☐

Next, I am going to ask some questions about your family's food situation.

23. In the past 12 months, did you or anyone else in your family worry that there would not be enough to eat because of a lack of money?

☐ Yes
☐ No
☐ Don't know

24. In the past 12 months, did you or anyone else in your family not have enough food to eat because of a lack of money?

☐ Yes
☐ No
☐ Don't know

25. In the past 12 months, did you or anyone else in your family not eat the quality or variety of foods that you wanted to eat because of a lack of money?

☐ Yes
☐ No
☐ Don't know

↬ If respondent answered Yes to any of Q 23, 24 OR 25, go to Q 26
↬ If respondent answered No or Don't know to all of Q 23, 24 AND 25, go to Q 29

---

26. In the past 12 months, how often did you or anyone in your family receive food from a food bank, soup kitchen or other charitable agency because there was not enough money for food?

☐ About every week
☐ About every other week
☐ About every month
☐ About 6 times
☐ About once or twice
☐ Not at all
☐ Don't know

27. In the past 12 months, how often did you or anyone in your family eat cheaper foods or eat the same foods for several days in a row because there was not enough money for food?

☐ About every week
☐ About every other week
☐ About every month
☐ About 6 times
☐ About once or twice
☐ Not at all
☐ Don't know

Identifier # ☐☐☐☐☐

28. In the past 12 months, how often did you or other members of your family skip meals or eat less than you should because there was not enough money for food?

☐ About every week
☐ About most every other week
☐ About every month
☐ About 6 times
☐ About once or twice
☐ Not at all
☐ Don't know

29. In some parts of Canada there are food action programs to help people with their food situation. Do you think any of the following programs would help you? (*Read definittions of programs.*)

a. Community Kitchens - a small group of people get together to plan, shop and cook for themselves and their families (usually in a community centre), sharing the cost, and taking the food home to be eaten.

☐ Yes
☐ No
☐ Don't know

b. Food Buying Clubs - a large group of people get together to buy food directly from wholesalers and local growers, to sort and package for delivery to or pick-up by club members.

☐ Yes
☐ No
☐ Don't know

c. Community Gardens - people grow fruits and vegetables for themselves and their families at a public garden usually with advice and support of volunteer gardeners.

☐ Yes
☐ No
☐ Don't know

d. Community Food Advisors - volunteers are trained to share their food skills in free workshops usually offered through community centres on preparing low cost, nutritious meals.

☐ Yes
☐ No
☐ Don't know

Identifier # ☐☐☐☐☐

Next I'm going to ask some questions about food shopping.

30. Thinking about the food in the store where you do or a member of your family does most of the food shopping, on a scale of 1 to 5 where 1 is strongly disagree and 5 is strongly agree, how would you respond to the following statements? (*Show response cards.*)

The food is reasonably priced.

1	2	3	4	5	
Strongly Disagree	Disagree	Neutral (neither agree nor disagree)	Agree	Strongly Agree	Don't Know

The food is of reasonable quality.

1	2	3	4	5	
Strongly Disagree	Disagree	Neutral (neither agree nor disagree)	Agree	Strongly Agree	Don't Know

There is reasonable variety in the food available.

1	2	3	4	5	
Strongly Disagree	Disagree	Neutral (neither agree nor disagree)	Agree	Strongly Agree	Don't Know

31. When available, do you choose to buy foods grown or produced in B.C. instead of food grown or produced elsewhere? (*Read response categories.*)

☐ Always
☐ Often
☐ Sometimes
☐ Never
☐ Don't know
☐ Don't shop

32. When available, do you choose to buy organically grown foods instead of conventionally produced foods? (*Read response categories.*)

☐ Always
☐ Often
☐ Sometimes
☐ Never
☐ Don't know
☐ Don't shop

Identifier # ☐☐☐☐☐

Now I'm going to ask you about your consumption of foods from sources outside of the commercial food supply. These include home-grown and wild foods.

33. In the past 12 months, did you eat any berries grown in B.C.? These include home-grown or wild strawberries, blueberries, raspberries, blackberries, salmonberries, huckleberries and gooseberries. *(Prompt - This does not include berries bought at the grocery store or farmers market or picked at a u-pick).*

☐ Yes

☐ No ➥ **go to question 34**
☐ Don't know ➥ **go to question 34**

Over what time period did you eat these berries, including berries that were made into jam, canned or frozen and eaten later in the past 12 months? *(Read list)*	In that time period, how often did you eat these berries? *(Prompt - either per day, per week, per month or per year)*		On average, how much did you eat each time you ate some?		COMMENTS
	#	DAY/D WEEK/W MONTH/M YEAR/Y	REFERENCE PORTION SIZE OR MODEL	HOW MUCH/ HOW MANY?	
☐ over 2 weeks ☐ over 1 month ☐ over 3 months ☐ over 6 months ☐ over 12 months ☐ other, specify:			1 SP-S (jam) ½ CUP		

34. In the past 12 months, did you eat any wild mushrooms grown in B.C.? *(Prompt - This does not include mushrooms bought in the grocery store or farmers market)*

☐ Yes ☐ No ➥ **go to question 35** ☐ Don't know ➥ **go to question 35**

Over what time period did you eat wild mushrooms in the past 12 months? *(Read list)*	In that time period, how often did you eat wild mushrooms? *(Prompt - either per day, per week, per month or per year)*		On average, how much did you eat each time you ate some?		COMMENTS
	#	DAY/D WEEK/W MONTH/M YEAR/Y	REFERENCE PORTION SIZE OR MODEL	HOW MUCH/ HOW MANY?	
☐ over 2 weeks ☐ over 1 month ☐ over 3 months ☐ over 6 months ☐ over 12 months ☐ other, specify:			½ CUP		

Identifier # ☐☐☐☐☐

35. In the past 12 months, did you eat any wild fish caught in B.C.? (*Prompt - This does not include fish bought in the grocery store or fish market or caught at a fish farm.*)

☐ Yes ☐ No ➥ **go to question 36** ☐ Don't know ➥ **go to question 36**

What kind of wild fish did you eat? (*Read list. Check (✓) all that apply*)	Over what time period did you eat this fish, including the fish that was smoked, canned or frozen and eaten later in the past 12 months? (*Read list*) A - over 2 weeks B - over 1 month C - over 3 months D - over 6 months E - over 12 months F - other (specify)	In that time period, how often did you eat this fish? (*Prompt - either per day, per week, per month or per year*)		On average, how much did you eat each time you ate some?	
		#	DAY/D WEEK/W MONTH/M YEAR/Y	REFERENCE PORTION SIZE OR MODEL	HOW MUCH/ HOW MANY?
☐ salmon				PC-S	
☐ salmon liver				1 liver	
☐ trout				PC-S	
☐ trout liver				1 liver	
☐ whitefish				PC-S	
☐ whitefish liver				1 liver	
☐ chub				PC-S	
☐ chub liver				1 liver	
☐ burbot				PC-S	
☐ burbot liver				1 liver	
☐ squawfish				PC-S	
☐ squawfish liver				1 liver	

COMMENTS:

36. In the past 12 months, did you eat any wild birds (such as duck, goose, partridge, quail and grouse) caught in B.C.? (*Prompt - This does not include wild birds bought in the grocery store or farmers market.*)

☐ Yes ☐ No ➥ **go to question 37** ☐ Don't know ➥ **go to question 37**

Over what time period did you eat wild birds, including the birds that were smoked or frozen and eaten later in the past 12 months? (*Read list*)	In that time period, how often did you eat wild birds? (*Prompt - either per day, per week, per month or per year*)		On average, how much did you eat each time you ate some?		COMMENTS
	#	DAY/D WEEK/W MONTH/M YEAR/Y	REFERENCE PORTION SIZE OR MODEL	HOW MUCH/ HOW MANY?	
☐ over 2 weeks ☐ over 1 month ☐ over 3 months ☐ over 6 months ☐ over 12 months					

Identifier # ☐☐☐☐☐

36. In the past 12 months, did you eat any wild birds (such as duck, goose, partridge, quail and grouse) caught in B.C.? (*Prompt - This does not include wild birds bought in the grocery store or farmers market.*)

☐ Yes ☐ No ➥ **go to question 37** ☐ Don't know ➥ **go to question 37**

Over what time period did you eat wild birds, including the birds that were smoked or frozen and eaten later in the past 12 months? (*Read list*)	In that time period, how often did you eat wild birds? (*Prompt - either per day, per week, per month or per year*)		On average, how much did you eat each time you ate some?		COMMENTS
	#	DAY/D WEEK/W MONTH/M YEAR/Y	REFERENCE PORTION SIZE OR MODEL	HOW MUCH/ HOW MANY?	
☐ other, specify:			PC-S		

37. In the past 12 months, did you eat any wild shellfish caught in B.C.? (*Prompt - This does not include shellfish bought in the grocery store or fish market.*)

☐ Yes ☐ No ➥ **go to question 38** ☐ Don't know ➥ **go to question 38**

What kind of shellfish did you eat? (*Read list. Check (✓) all that apply*)	Over what time period did you eat this shellfish, including the shellfish that was canned or frozen and eaten later in the past 12 months? (*Read list*) A - over 2 weeks B - over 1 month C - over 3 months D - over 6 months E - over 12 months F - other (specify)	In that time period, how often did you eat this shellfish? (*Prompt- either per day, per week, per month or per year*)		On average, how much did you eat each time you ate some?	
		#	DAY/D WEEK/W MONTH/M YEAR/Y	REFERENCE PORTION SIZE OR MODEL	HOW MUCH/ HOW MANY?
☐ shrimp / prawns					
☐ oysters / mussels / clams					
☐ crab					
☐ crab digestive organs (show picture)					
COMMENTS:					

38. In the past 12 months, did you eat any wild game (such as caribou, deer or rabbit) caught in B.C.? (*Prompt - This does not include game bought in the grocery store or farmers market.*)

☐ Yes ☐ No ➥ **go to next questionnaire** ☐ Don't know ➥ **go to next questionnaire**

Identifier # ☐☐☐☐☐

(*Probe to find out if muscle, liver or kidney, was eaten*)	Over what time period did you eat wild game, including the game that was smoked, made into sausages or frozen and eaten later in the past 12 months? (*Read list*) A - over 2 weeks B - over 1 month C - over 3 months D - over 6 months E - over 12 months F - other (specify)	In that time period, how often did you eat wild game? (*Prompt - either per day, per week, per month or per year.*)		On average, how much did you eat each time you ate some?	
		#	DAY/D WEEK/W MONTH/M YEAR/Y	REFERENCE PORTION SIZE OR MODEL	HOW MUCH/ HOW MANY?
☐ muscle				PC-S	
☐ liver				1 liver	
☐ kidney				1 kidney	
COMMENTS:					

Appendix E

Demographic Questionnaire

Identifier #

B. C. DEMOGRAPHIC QUESTIONNAIRE (Fall Session) FORM E

In order to compare your answers with those provided by people from similar backgrounds, I would like to ask you a few questions about yourself.

1. (*Confirm with the respondent the date of birth provided on label.*)

day month year

2. (*Confirm the gender provided on the label.*)

☐ Male
☐ Female

3. What is your current marital status? Are you: (*Read list.*)

☐ Married or *Living Common Law
☐ Divorced
☐ Separated
☐ Widowed
☐ Never Married

*Common Law is defined as adults of the opposite sex or same sex living together in a sexual union of 3 months or more duration. Ref.- Statistics Canada

4a. How many years have you spent in school, including the equivalent of elementary, high school, technical college and university, but not including kindergarten? (*Probe for full-time versus part-time. Full-time is 24 hours or more of class time per week; part-time is less than 24 hours of class time per week.*)

Full-time years

Part-time years

In what country did you complete most of your education? ________________

4b. What is your highest grade or level of education? (*Do NOT read list. Check (✓) only one. Some probing may be required since a distinction is required between "some" and "completed".*)

☐ No schooling
☐ Some Elementary
☐ Completed Elementary
☐ Some Secondary
☐ Completed Secondary
☐ Some Trade / Vocational Training
☐ Completed Trade / Vocational Training
☐ Some University
☐ Certificate or Diploma below Bachelor's Level
☐ Bachelor's Degree or Above

Identifier # ☐☐☐☐☐

5. In the past 12 months, did your family receive income from any of the following financial assistance programs: *(Read list. Family is defined as a group of individuals related by blood, marriage including common-law, or adoption, who share a common dwelling unit at the time of the survey. Ref. - Statistics Canada. See definitions of financial assistance programs below if necessary)*

☐ Child Tax Benefit
☐ Guaranteed Income Supplement or Spouse's Allowance
☐ Income Assistance or Welfare
☐ Employment Insurance
☐ None of the above

Child Tax Benefit is paid to low-income families with children.
Guaranteed Income Supplement is paid to Old Age Security recipients who have little or no other income.
Spouse's Allowance is an income-tested, monthly benefit paid to the 60-64 year old legal or common-law spouse of an Old Age Security recipient, if that recipient is eligible for the Guaranteed Income Supplement.
Income Assistance or Welfare refers to B.C. Benefits which is an umbrella term for several benefit programs, namely Income Assistance, Youth Works, Disability Benefits and Child Care Benefits.
Employment Insurance benefits are paid to people who are available for and able to work but cannot find a job, and to those unable to work owing to illness, maternity or caring for a new-born or newly adopted child.

6a. How many people in your family are aged (include self): (*Family is defined as a group of individuals related by blood, marriage including common-law, or adoption, who share a common dwelling unit at the time of the survey. Ref. - Statistics Canada.*)

0 - 18 years ☐

19 - 64 years ☐

65+ years ☐

6b. How many people are in your household, including non-family members (include self)?

☐ # of people

7. Please look at the card and tell me, as close as you possibly can, the code which corresponds to your family income before taxes in the year 1998. (*Family is a group of individuals related by blood, marriage including common-law, or adoption, who share a common dwelling unit at the time of the survey. Ref. - Statistics Canada.*)

Income Range	Code
≤12,000	A
12,001-15,000	B
15,001-20,000	C
20,001-25,000	D
25,001-30,000	E
30,001-35,000	F
35,001-40,000	G
40,001-45,000	H
45,001-55,000	I
> 55,000	J
Don't know	K
Refused	L

☐ Code

Identifier # ☐☐☐☐☐

8. Do you identify yourself as an aboriginal or First Nations person? This includes Indian, Inuit or Metis.

☐ Yes
☐ No

9a. Have you smoked 100 or more cigarettes in your life?

☐ Yes
☐ No → **go to question 10**
☐ Refused → **go to question 10**

9b. Do you usually smoke cigarettes every day?

☐ Yes
☐ No → **go to question 9d**
☐ Refused → **go to question 10**

9c. How many cigarettes do you smoke a day?

☐☐☐ # cigarettes per day

9d. (*The interviewer needs to record in the table below, the age at which the respondent started smoking, the age at which the respondent quit smoking, and the average daily consumption of cigarettes during that time period. This information should be recorded for* ***all smoking periods*** *in the respondent's life; ie. - the respondent may have quit smoking and then picked up the habit again more than once in his life. Once collected, this information will be entered into a computer and it will calculate average daily cigarette consumption.*)

Probing questions:

"At what age did you start smoking?"

" At what age did you quit smoking?"

"Did you quit smoking for one year or more and then restart more than once?"
IF YES, **"At what age did you start and quit smoking for each smoking period?"**
IF NO, go to next question

"On average, how many cigarettes did you smoke per day during the period from age_____ to age _____?"

IF respondent is a current smoker, record his present age in the "Age Stopped" column in the last Episode.

Episode	Age Started	Age Stopped *Or current age if still smoking*	Average Daily Consumption
1			
2			
3			

10. Have you smoked cigars or cigarillos 100 or more times in you life?

☐ Yes
☐ No
☐ Don't know
☐ Refused

The following question 11, 12 and 13 may sound repetitive, but they need to be asked in a specific way in order for the results to be compared to other provinces.

11a. During the past month, did you eat bread?

☐ Yes
☐ No → **go to question 12**

11b. What type of bread did you usually eat? (*Do NOT read list. Check (✓) only one.*)

☐ Whole wheat (100%, 60%)
☐ Multigrain / Cracked wheat
☐ White bread
☐ Rye / pumpernickel
☐ Other, specify: __________
☐ Don't know

12a. During the last month, did you use milk?

☐ Yes
☐ No → **go to question 13**

12b. What type of milk did you usually use? (*Do NOT read list. Check (✓) only one.*)

☐ Whole milk
☐ 2% milk
☐ 1% milk
☐ Skim milk
☐ Powdered skim milk
☐ Evaporated milk
☐ Other
☐ Don't know

13. During the past month, did you take any vitamin-mineral supplements?

☐ Yes
☐ No

Identifier #

We have reached the end of the questions. All that is left is for me to take some body measurements – your weight, height, and waist and hip circumferences.

14. Anthropometrics

Weight used for calibration . Kg

Weight on scale of calibration weight: . Kg

Weight: (*note on comment line if measurement may not be accurate and why*)

. Kg

or

. Lbs

☐ Measured
☐ Self-Reported (specify reason)
☐ Refused
Comments / Reason for Self-Report:

Height: (*note on comment line if measurement may not be accurate and why*)

. cm

or

feet . inches

☐ Measured
☐ Self-Reported (specify reason)
☐ Refused
Comments / Reason for Self-Report:

If the respondent is 50 years old or over, ask the following question(s) regarding age-related height loss.

Are you aware of any changes in your height in your adult life?

☐ Yes →→→
☐ No → **go to waist measurement**

How tall were you at age 20?

. cm

or

feet . inches

☐ Don't know

Waist Circumference:

☐ Refused

First Measurement . cm

Second Measurement . cm

*Third Measurement . cm

* only if difference between the first 2 measurements is > 0.4 cm

Identifier # ☐☐☐☐☐

Hip Circumference:

☐ Refused

First measurement	Second measurement	*Third measurement
☐☐☐.☐ cm	☐☐☐.☐ cm	☐☐☐.☐ cm * only if difference between the first 2 measurements is > 0.4 cm

Thank you for your participation in the Survey. Your commitment of time and willingness to provide personal information is greatly appreciated.

Appendix F

Non-Response Questions

B.C. NUTRITION SURVEY – NON-RESPONSE QUESTIONS FORM A-2

Interviewer ID ☐☐

Identifier # ☐☐☐☐☐

If you face a refusal (02) or Location verified, temporary no contact (03): *(Read the following)*
In order to determine if people who say yes to the study are different than people who say no to the study, I would like to ask you 6 quick questions about your eating habits and your background.

1. During the past month, did you eat bread?

☐ Yes ☐ No

If yes, what type of bread did you usually eat? *(Do NOT read list. Check (✓) only one.)*

☐ Whole Wheat (100%, 60%)
☐ Multigrain/Cracked Wheat
☐ White Bread
☐ Rye, Pumpernickel
☐ Other: ____________________
☐ Don't know

2. During the past month, did you use milk?

☐ Yes ☐ No

If yes, what type of milk did you usually use? *(Do NOT read list. Check (✓) only one.)*

☐ Whole milk
☐ 2% milk
☐ 1% milk
☐ Skim milk
☐ Powdered milk
☐ Evaporated milk
☐ Other: ____________________
☐ Don't know

3. During the past month, did you take any vitamin-mineral supplement?

☐ Yes ☐ No

4. Have you smoked 100 or more cigarettes in your life?

☐ Yes ☐ No ➥ **go to Q5** ☐ Refused ➥ **go to Q5**

Do you usually smoke cigarettes every day?

☐ Yes ☐ No ➥ **go to Q5** ☐ Refused ➥ **go to Q5**

How many cigarettes do you smoke a day?

☐☐☐ # cigarettes per day

Identifier # ☐☐☐☐☐

5. What is your current marital status? Are you: (*Read list.*)

01☐ Married or * Living Common Law
02☐ Divorced
03☐ Separated
04☐ Widowed
05☐ Never Married

*Common Law is defined as adults of the opposite sex or same sex living together in a sexual union of 3 months or more duration.

6. What is your highest grade or level of education? (*Do NOT read list. Check (✓) only one. Some probing may be required since a distinction is required between "some" and "completed".*)

01☐ No schooling
02☐ Some Elementary
03☐ Completed Elementary
04☐ Some Secondary
05☐ Completed Secondary
06☐ Some Trade / Vocational Training
07☐ Completed Trade / Vocational Training
08☐ Some University
09☐ Certificate or Diploma below Bachelor's Level
10☐ Bachelor's Degree or Above

These are examples of the study questions, would you like to reconsider full articipation in the study?

Thank you for your time.

Appendix G

Participant's Letter

BRITISH
COLUMBIA

September 13, 1999

Dear Resident:

The Ministry of Health and the Ministry Responsible for Seniors, the University of British Columbia and Health Canada are conducting a study of British Columbians' food habits and the factors that influence these food choices. Since 1990, Health Canada has sponsored similar studies in the other provinces, and this study in British Columbia will complete the national nutrition picture.

Approximately 2500 British Columbians will be included in this study. Your name has been chosen at random from the Ministry of Health Client Registry as a potential participant. While participation in the study is voluntary, your involvement would be valuable for several reasons. The information collected will help plan nutrition programs and services in the province. As well, the data from British Columbia will be combined with that from other provinces to help in understanding the eating habits of all Canadians. This information will help set food policies that ensure a consistent, safe and nutritious food supply for our nation. We hope that you will consider these factors and contribute your time to participate in this important project.

Between September 13 and December 10, 1999, a public health nurse or nutritionist will telephone you to ask for your participation and to answer any questions you may have. Should you agree to participate, this interviewer will come to your home at your convenience to collect the necessary information. The interviewer will ask you questions regarding your eating habits and will measure your weight, height, waist and hips. All measurements will be taken over light weight street clothes. The interview will last approximately 90 minutes. You may also be asked to take part in a follow-up interview a short time later.

All information that you provide will be held in strict confidence. Your name will not appear in any reports that arise from this study. You may refuse to answer any specific questions or to have body measurements taken. Also, if you agree to participate and then change your mind about participating, you may withdraw from the study at any time.

...2

Ministry of Health and
Ministry Responsible for Seniors

Public and Preventive Health Services
Preventive Health Branch

1520 Blanshard Street, 2nd Floor
Victoria BC V8W 3C8

Telephone: (250) 952-1536
Facsimile: (250) 952-1570

Should you, at any time, have questions regarding the study, please feel free to contact Lisa Forster-Coull, Principal Investigator, Ministry of Health and Ministry Responsible for Seniors, at (250) 952-1536. For further information, you can call the Ministry of Health's toll free number 1-800-465-4911.

We hope that you agree to participate in this important study. The information you provide will assist all British Columbians in making healthy food choices.

Sincerely,

Lisa Forster-Coull	Dr. Ryna Levy Milne	Lynne Blair	Dr. Robert Fisk
Principal Investigator	Co-Investigator	Co-Investigator	Co-Investigator
Nutritionist	Assistant Professor	Manager	Epidemiologist
Ministry of Health	University of British Columbia	Ministry of Health	Ministry of Health
(250) 952-1536	(604) 822-6869	(250) 952-1534	(250) 952-1464

Si vous désirez cette correspondence en français, s.v.p. téléphonez au bureau d'enquête au 1-250-952-2321.

If you have recently moved or changed your telephone number, please contact the survey office at (250) 952-2321 or call the Ministry of Health's toll-free number at 1-800-465-4911 to leave a message. Thank you.

Appendix H

Request for Response Letter

BRITISH
COLUMBIA

May 3, 1999

Dear

The Ministry of Health and the Ministry Responsible for Seniors, the University of British Columbia, and Health Canada are conducting a study of British Columbians' food habits and the factors that influence food choices. Approximately 2500 British Columbians will be included in this study. Your name has been chosen at random from the Ministry of Health Client Registry as a potential participant.

You have likely already received a letter outlining the study in more detail, and asking if you would like to participate. However, our survey staff working in your area have been unable to contact you. If you are interested in taking part in this survey, please call the survey office at (250) 952-2321.

If you have questions or want more information you can call the Ministry of Health toll-free number at 1-800-465-4911, or call me at (250) 952-1536. Thank you.

Sincerely,

Lisa Forster-Coull
Principal Investigator
British Columbia Nutrition Survey

LFC:ma

Ministry of Health and
Ministry Responsible for Seniors

Public and Preventive Health Division
Preventive Health Branch

1520 Blanshard St, Second Floor
Victoria BC V8W 3C8

Telephone: (250) 952-1536
Fax: (250) 952-1570

Appendix I

Thank You letter

BRITISH
COLUMBIA

Date:__________________

Dear :

On behalf of the British Columbia Nutrition Survey Team, I would like to thank you for your participation in this survey. Your commitment of time and your willingness to provide dietary information is greatly appreciated.

It is well known that eating habits play a significant role in helping to maintain and improve health. The information gathered in the British Columbia Nutrition Survey will give health professionals a much better understanding of the eating habits of British Columbians. As a result, nutrition programs and policies can be developed that will help to improve the health and well-being of all British Columbians.

During your interview, you may have asked when the results of the survey would be available. It is anticipated that the compiled results will be available some time in the year 2001. The results of the survey will be announced to the media at that time, and copies of the survey will also be available from the Ministry of health and Ministry Responsible for Seniors.

Once again, thank you very much for being part of the British Columbia Nutrition Survey.

Sincerely,

____

Interviewer
British Columbia Nutrition Survey

____

Lisa Forster-Coull
Principal Investigator
British Columbia Nutrition Survey

Ministry of Health and
Ministry Responsible for Seniors

Preventive Health Branch
Public and Preventive Health Services

1520 Blanshard Street, 2nd Floor
Victoria BC V8W 3C8

Telephone: (250) 952-1533
Facsimile: (250) 952-1570

Appendix J

Data Entry Form (A-1)

BRITISH COLUMBIA NUTRITION SURVEY
DATA ENTRY FORM A-1

DATE FILE CLOSED: ☐☐ ☐☐ ☐☐
day month year

01☐ Interview Obtained in ☐ English ☐ Punjabi ☐ Chinese

or ☐ No Interview Obtained

⇩

REASON FOR NO INTERVIEW:

☐ Non Responding → reason for non-response:
- 02☐ Refusal, Reason: ________________ → **Form A-2 completed** ☐Yes ☐No
- 03☐ Location verified, temporary no contact ↗
- 04☐ Language
- 05☐ Made appointment, failed to show or cancelled
- 06☐ Other: ________________________

☐ Not Resolved → reason not resolved:
- 07☐ Letter returned, no further info
- 08☐ No answer after at least 6 phone attempts
- 09☐ Cannot locate by phone or home visit
- 10☐ Other: ________________________

☐ Not Eligible → reason not eligible
- 11☐ Dead
- 12☐ Pregnant/Nursing
- 13☐ Moved out-of-province
- 14☐ Moved within province, but out of all the sampling regions
- 15☐ Hospitalization/extraordinary illness
- 16☐ Living in Institution or Reserve
- 17☐ Other: ________________________

SIGN OFF CONTROL CHECK (ID CODES):

INTERVIEWER ☐☐	**FACILITATOR** ☐☐
Interviewer's Opinion of the Information:	Final Status of Interview:
☐ Reliable	☐ Reliable complete response
☐ Unable to recall one or more meals	☐ Reliable partial response
☐ Unreliable, reason: ______________	☐ Unacceptable response

TOTAL # OF PAGES IN PKG ☐☐

COORDINATOR ☐☐

Appendix C

Appendix K

Informed Consent Form

BRITISH
COLUMBIA

Informed Consent for Interviewed Participants
British Columbia Nutrition Survey

The British Columbia Nutrition Survey is a province-wide study being conducted by representatives of the Ministry of Health and Ministry Responsible for Seniors, the University of British Columbia, and Health Canada. It is designed to describe the food habits of British Columbians.

The study will include 2500 adults between the ages of 18 and 84 years, chosen at random from the Ministry of Health Client Registry. The interview will include:

- a recall of what you have eaten in the past 24 hours;
- information regarding the frequency with which you eat specific foods;
- questions about specific food and nutrition issues; and
- measurements of your height, weight, waist and hips, taken in light-weight street clothes.

The interview will take approximately 90 minutes. Participation in the study is voluntary. If you agree to participate in the study, you may be one of a small number of people asked to repeat a portion of the interview a short time later.

In addition, you may be recontacted in the future for future research purposes. You may refuse to participate in future research. If you agree to participate in future research, a new informed consent for participants would be required.

All information you provide to the interviewer will be kept in strict confidence. Your name will not appear in any reports that arise from the study. All subject names will be coded and protected by use of a study number. As well, documents will be kept in a locked filing cabinet. Data records will be kept on computer hard drive (accessed by password) and on floppy disk (stored in a locked filing cabinet). The data obtained from this study may be shared by the Ministry of Health with other British Columbia health agencies for research purposes. Access to the data will follow strict research protocols and the safeguards of the Freedom of Information and Protection of Privacy Act.

Your participation is important because it will help plan nutrition programs and services in British Columbia. However, your rights to health care in the province or Canada will not be affected by your choice to participate or not participate in the study.

...2

If you have any questions or desire further information with respect to this study, you may contact Lisa Forster-Coull, Principal Investigator, Ministry of Health and Ministry Responsible for Seniors, at (250) 952-1536.

If you have any concerns about your treatment or rights as a participant, you may contact Dr. Richard Spratley, Director of Research Services, University of British Columbia, at (604) 822-8598.

Consent:

I understand that my participation in the study is voluntary and that all the information that I provide will be held in strict confidence. My name will not appear in any reports that arise from data collected in the study. I may withdraw at any time or refuse to answer specific questions or have my body measurements taken.

I understand that I will not be paid for my participation in this study.

I have received a copy of this consent form for my own records.

Participant	Date
Signature of Interviewer (Witness)	Date

Lisa Forster-Coull Principal Investigator Nutritionist Ministry of Health (250) 952-1536	Dr. Ryna Levy Milne Co-Investigator Assistant Professor University of British Columbia (604) 822-6869	Lynne Blair Co-Investigator Manager Ministry of Health (250) 952-1534	Dr. Robert Fisk Co-Investigator Epidemiologist Ministry of Health (250) 952-1464

Appendix L

Methodology for Estimating Usual Intake

British Columbia Nutrition Survey 1999
Methodology for Estimating Usual Intake

BBCA Technical Report 451311-011
October 9, 2002

S. Hayward
B. Junkins
Bureau of Biostatistics and
Computer Applications
Food Directorate
Health Canada

British Columbia Nutrition Survey
Methodology for Estimating Usual Intake

1. Introduction
    - 1.1 Background
    - 1.2 Sample Design

2. Estimation of Usual Intake From Food
    - 2.1 Normality and outliers
    - 2.2 Estimation of inter-individual and intra-individual variability

3 Usual Intakes from Food and Supplements
    - 3.1 Supplement intake reporting and estimation of usual supplement intake
    - 3.2 Correlation of supplement intake and combining intakes from food and supplements
    - 3.3 Fixed effects

4. Results and Discussion

5. References

6. Tables

7. Graphs

British Columbia Nutrition Survey
Methodology for Estimating Usual Intake

1.0 Introduction

Population surveys are used to collect information on dietary knowledge, attitudes, behaviours and food and nutrient intake at an individual level. These data are used for many purposes including the development and evaluation of food and nutrition programs, incorporation in probabilistic exposure models for risk assessment, identification of emerging concern and perceptions of dietary trends.

The British Columbia Nutrition Survey (BCNS) is one of a series of Federal Provincial surveys designed to gather data to meet the needs of provincial researchers, health authorities and the Food Program in Health Canada. The 24 hour recall data are used to capture detailed information on all of the foods and beverages consumed in the previous 24 hour period. These data are of particular interest because the data includes both variability between individuals (inter-individual variation) and day to day variability for each individual (intra-individual variation). While standard analytical procedures can be used to estimate population means, these methods are not appropriate when describing the "usual" intake of the population, the percentiles of intake, or perhaps the proportion of the population who usually consumes above (or below) a specific cut-point. This report discusses the statistical methods used in the BCNS to estimate the distribution of usual intakes.

1.1 Background

The British Columbia Nutrition Survey (BCNS) was conducted as a federal-provincial collaboration in two phases: April-July 1999 (spring) and September-December 1999 (fall). During this time, men and women between the ages of 18 and 84, living in British Columbia (excluding those who were pregnant, lactating, institutionalized or living on reserve lands) were approached through an initial letter and telephone follow-up to participate in a food and nutrition survey. For those who agreed to participate, an "at home" visit was conducted by a member of a specially trained team of interviewers. These interviewers had completed a training course designed by Health Canada that was specifically dedicated to standardizing the collection of the diet and nutrition information using the various survey instruments. The recall data were collected during a face-to-face interview.

The survey consisted of five instruments: a 24 hour recall, a quantitative food frequency questionnaire, a demographic questionnaire, a provincial special interest questionnaire and information pertaining to the response/non-response status of sampled individuals. Approximately, half of the sample was interviewed during the Spring and the other half in the Fall of 1999. There was a repeat 24-hour recall for a sub-sample of the participants, every third name sampled being identified for a repeat. Both the initial and repeat interview days were randomly assigned to cover all days of the week, and the repeat interview was scheduled no sooner than one week after the first interview.

The data for all sampled individuals, responders and nonresponders, were entered by the Nutrition Research Division (NRD) in the Food Directorate in Health Canada using the in-house software NSS (Nutrition Survey System). This system was developed in the Food Directorate in Health Canada specifically for data entry and retrieval. The data were transferred from the NSS system to files for the statistical software SAS by FID. The data bases generated from this survey can be used for in depth analyses of inter-relationships between variables, nutrient, provenance and various other concerns related to health and nutrition.

1.2 Sample Design

The sampling plan for both phases, (or seasons), designed by the Special Surveys Methods Division in Statistics Canada (France Bilocq (1999)) was a stratified multi-stage sampling design. At the first stage of the sample selection, the population was stratified into three strata: Metro (stratum 1) consisting of 6 geographic regions (or sub-strata); Coastal (stratum 2) containing 1 geographic region (sub-stratum); and Non-metro consisting of 10 geographic regions (clusters). In strata one and two, each geographic region (substratum) was selected with certainty, termed "chosen with probability 1", while in stratum three, 4 geographic regions (or clusters) were randomly chosen with probability proportional to the population size of the regions, excluding remote areas accounting for less than four percent of the population. The British Columbia Health Register File (BCHR) was used as the frame to select the sample of individuals for each season. All individuals on the BCHRF that fell within the selected areas for each stratum were stratified into 14 age-sex groups: males/females, ages 18-24, 25-34, 35-44, 45-54, 55-64,65-74 and 75-84.

At the second stage, a sample of individuals was selected from the BCHR according to the sample allocation in each stratum-age-sex combination. An estimate of 5320 names was required to drawn in the Spring 1999 and divided equally for two seasons in order to obtain expected responses of 1364 in each season. The dividing process was done as the first, third, fifth name sampled ... etc., being identified for Spring (phase 1) and the second, fourth, sixth name sampled .... etc., being identified for Fall (phase 2). For more detailed information about the sample design, see Sample Design Specifications (France Bilocq, 1999).

A detailed analysis of response/nonresponse issues in the main study was conducted by the Statistics and Epidemiology Division in BBCA which is described in the technical document (BBCA E451311-011NR, L. Nguyen, B. Junkins (2002)). This document includes: the methodological development of sampling weights, detailed analyses of response rates and patterns, and assessment of magnitude and direction of potential bias.

In general, of the eligible individuals, 52% (1823) provided usable first interviews. While the survey design called for 1/3 of the interviews to be repeated, 26.3% of the interviews were repeated: in some age-sex groups the rates were closer to 20%. As noted in the nonresponse document there is evidence to suggest that bias may be present in the responding population due to over-representation of higher educated, nonsmokers who take vitamin supplements relative to the general population. Publication or release of data or analyses from the BCNS, including those pertaining to usual intakes, should disclose fully the nonresponse factors pertinent to interpretation of the results.

To incorporate the survey design into the development of sample variances, specialized software packages can be used (such as PC Carp, SUDAAN, Stata, Wes Var Complex Samples) employing various techniques such as Taylor linearization, the jackknife or the bootstrap. (See Cochran (1977) and Rust and Rao (1996) for statistical information on variance estimation in complex surveys).

2. Estimation of Usual Intake

Food intake reported by individuals varies for a number of reasons. First, we see variation because intakes vary from person to person: this is termed *between* person or *inter*-individual variability. However, single individual intakes also vary because people eat differently from day to day: this is termed *within* person, or *intra*-individual variability. The presence of these two components of variance results in a single day distribution of intakes for the population which is wider, with longer tails, than would be the distribution of usual intake. As a result, if the single day intake is used to examine the proportion of the population with usual intake exceeding a set point, that proportion would be an overestimate. Using single day intakes to estimate percentiles of population intakes will tend to exaggerate the proportion of individuals in the tails, or extremes of the intake distribution and can provide a significant misrepresentation. (For more information on the effect of day to day variability in dietary intakes see Liu *et. al* 1978, or Beaton *et. al.* 1979). However, there is great interest and need to provide estimates of percentiles of usual intake as well as to examine the distribution relative to fixed reference points. As a result, a method to derive a usual distribution from one day intakes is required.

The method of estimating the distribution of usual intakes described below is an adaptation of the method described by the US National Research Council in 1986. This stratum adjusted method reported in Karpinski and Nargundkar (1992) was developed and first used for the Nova Scotia Nutrition Survey (1992) where it was peer reviewed by an international panel. This method has also been evaluated at the Consensus Workshop on Dietary Assessment (1994).

A two-step procedure is used: first, find a normalizing transformation; and second, employ a linear transformation which provides a distribution of intakes without the intra-individual component. The modification of the NRC approach takes the form of using a hierarchical or nested Analysis of Variance (ANOVA) to accommodate different means in homogeneous subgroups during the calculation of the variance components.

These steps are detailed below.

The following notation will be used:

a:	geographic stratum or season	a = 1 (Metro), 2(Coastal), 3 (Non-Metro) a = 1,2
i:	age/gender sampling group	i = 1, 2, ...,7 for males i = 8, 9, ..., 14 for females
k^{th} individual in the ai th sampling stratum		$k = 1,2,\ldots,k_{ai}$

s:	supplement use	s= 0,1 (if indicated taking supplements last month)
f:	recall number for the kth individual.	f=1 for first interview and 2 for repeat recall.

It should be noted here that information about supplement use was not collected in all past federal-provincial surveys and that geographic stratum and season variables were both included in the model used to adjust the data. However, a supplement use variable was of interest for the role it might play when looking at the usual vitamin intakes from foods alone, as well as the total from foods plus supplements. The BC survey was the first survey for which such information was available. The choice of fixed effects is discussed in the context of estimation of usual intakes from both food and supplements in section 3.3.

2.1 Normality and Outliers

At the outset, an analysis was carried out using the observed single day intakes estimated for each nutrient or derived dietary variable (such as percent calories from lipids) of interest. This step is used to determine the scale on which the responses follow a Normal distribution as well as to identify outliers in the observed data set which could exert a large influence on the parametric analyses used to estimate intra- and inter- individual variance components. Four transformations are considered: the raw or untransformed scale, the square root scale, quarter root scale and the logarithmic scale. The raw scale and the log scale provide extremes for a class of power transformations, while the square root and quarter root scales provide intermediate powers for cases which are clearly not normal or log normal.

Let

X_{aiksf} represent the observed value for a particular nutrient;

and $Y_{aiksf}=\mathcal{F}(X_{aiksf})$ represent the normally transformed value of X_{aiksf}.

For each nutrient, analysis scale and sampling age-sex category, an analysis of variance was carried out for the following general model:

$$Y = G + \delta \qquad \text{...(1)}$$

where G represents the fixed main effects for sampling strata (i.e., age group, sex, season, geographic region) and δ represents the random variation in average dietary intakes between subjects and the random day - to - day variation within a particular subject.

Assume for each age and sex category, that the random between subject effects follow a Normal distribution with mean zero and variance σ^2_{inter}. Assume further that the random variations within subjects follow a Normal distribution with zero mean and variance σ^2_{intra} and that these random errors between individuals and within individuals are independent of each other, and independent of the fixed effects. Then the analysis of variance of residuals (i.e., the difference between observed Y and the Y from model (1)) should have a distribution which is approximately Normal with zero mean and variance $\{ \sigma^2_{inter} + \sigma^2_{intra} \}$. A Shapiro-Wilk W test (D'Agostino and Stephens,1986) for

Normality is carried out on the analysis of variance residuals for each age-sex category. Standardized residuals (i.e., residual/square root of the residual mean square error) whose absolute value exceed 3.090 (standardized Normal deviate at the 0.001 level) are tentatively regarded as outliers. Normality tests are repeated for each age-sex category after eliminating identified outliers. An additional cycle of outlier elimination and Normality testing is carried out in order to reduce the impact of outliers on the results of Normality tests.

An additional test for 'within subject' outliers is also carried out. Given the assumptions above, the differences between replicate observations within individuals should follow Normal distribution with zero mean and common variance. Standardized differences, (i.e., (difference - mean)/standard deviation of differences), are tentatively eliminated as outliers if the absolute value exceeds 3.090.

The p-values for the Shapiro-Wilk W test for normality on the data set with outliers removed, are combined across the 6 pooled age-sex categories using Fisher's method (Steele and Torrie, 1960). The combined p-value is used as the basis for selecting the scale which most closely approximate Normality.

2.2 Estimation of inter-individual and intra-individual variability

The variation in the 24 hour recall can be partitioned into two main components (Beaton et. al., 1983): inter-individual (or between) variation and intra-individual (or within person) variation. As indicated in the National Research Council 1986 document on Nutrient Adequacy, age and sex are expected to be the primary determinants of the relative size of each of these components of variation. The technique below, as mentioned above, includes factors such as season or geographical region and supplement use as additional determinants in order to increase the homogeneity within each stratum in the analysis of variance.

Consider the following repeated measures model where the observed nutrient X has been transformed to Y by the function $\mathcal{T}$ (such as log for example) to the most appropriate analysis scale and outliers eliminated:

$$Y_{aiksf} = \mu_{ais} + c_{ais(k)} + e_{aisk(f)} \quad \ldots (2)$$

where

μ_{ais} represents the fixed effect of stratum (a,i,s)
$c_{ais(k)}$ represents the random variation in average intake for subject k in stratum (a,i,s)
$e_{aisk(f)}$ represents the random variation for day f within subject k in stratum (a,i,s)

(For more information about random effects models and repeated measures models see standard texts such as Snedecor and Cochran (1980) and Searle et al (1992))

The same assumptions are made as above in the analysis of outliers, the $c_{ais(k)}$ and $e_{aiks(f)}$ are independent random variables with variances $\sigma^2_{inter(i)}$ (between) and $\sigma^2_{intra(i)}$ (within) respectively for the age-sex group i. These components of variance are used to develop the adjustment variable R_i defined below and transform the single day intakes into a usual distribution.

Repeat 24 hour recalls are used to measure the day to day variability in diet within an individual. The analysis of variance and expected mean squares for each age-sex group are completed based on method of moments for hierarchical classifications with unequal numbers. (Kempthorne, 1952) Estimates of the variance components are obtained by equating the observed mean squares with the corresponding expected mean squares and solving the resulting equations for estimates of $s^2_{inter(i)}$ and $s^2_{intra(i)}$.

Within each recall collection, (i.e., either the initial or repeat recall component), the Y_{aiskf} have a normal distribution with mean μ_{aisf} and variance $\sigma^2_{inter(i)} + \sigma^2_{intra(i)}$. A distribution of average subject intakes which is free from intra-individual variation can be simulated from the original distribution by a linear transformation of the form:

$$Z(Y)_{aiskf} = \mu_{aisf} + R_i\,(Y_{aiskf} - \mu_{aisf}) \qquad \text{... (3)}$$

where

$$R_i = \sqrt{\frac{\sigma^2_{inter(i)}}{\sigma^2_{intra(i)} + \sigma^2_{inter(i)}}} \qquad \text{... (4)}$$

R_i increases to 1 as the ratio of $\sigma^2_{intra(i)}$ to $\sigma^2_{inter(i)}$ becomes small: i.e., when the intra-individual variation is much smaller than the inter-individual variation. (This ratio of the "within to between" components is often reported in the literature.)

The transformed variable $Z(Y)_{aikf}$ then follows a Normal distribution with mean μ_{aif} and variance $\sigma^2_{inter(i)}$. The mean and variance parameters are unknown, however, a suitable approximation is obtained by substituting the estimated stratum means and variance components. Hence, on the transformed scale adjusted responses can be defined by

$$z(y)_{aiskf} = \overline{Y}_{aisf} + \hat{R}_i(y_{aiskf} - \overline{Y}_{aisf}) \qquad \text{... (5)}$$

where: $\overline{Y}_{aisf}$ is the mean of the stratum (a,i,s,f);

and

$$\hat{R}_i = \sqrt{\frac{s^2_{inter(i)}}{s^2_{intra(i)} + s^2_{inter(i)}}} \qquad \text{... (6)}$$

where $s^2_{inter(i)}$ and $s^2_{intra(i)}$ are sample estimates for $\sigma^2_{inter(i)}$ and $\sigma^2_{intra(i)}$ respectively

Rearranging (5) we can write:

$$z(y)_{aiskf} = (1-\hat{R}_i)\overline{Y}_{aisf} + \hat{R}_i(y_{aiskf}) \qquad \ldots (7)$$

From (7), we see that the observations are adjusted by "shrinking" them toward the mean. One way to understand this process is to consider the extremes: when $\hat{R}_i$ =0, so that only day to day variability is present, then the observations would be replaced by the mean; when $\hat{R}_i$ =1, so that no day to day variability is present, then the original data points are used. When both intra- and inter-person variability is present then the data are adjusted to a value between these extremes.

The inverse transformation is then applied to the z(y)'s to derive the adjusted responses on the original scale, i.e., Z_{aiskf}: that is,

$$Z_{aiskf}=\mathcal{F}^{-1}[z(y_{aiskf})].$$

The adjustments are applied to all of the observations, including those classified as outliers and which are not included in either the normality analysis or the variance component estimation. The empirical distribution of the adjusted responses preserves the same shape as the original variables, and will have approximately the same median.

During the estimation of the variance components, the method of moments can result in negative values for the inter-individual variability. This can be due to a number of reasons including small sample size and the presence of influential observations not identified at the outlier detection step. It is also possible that while not negative, the inter individual variability will be very close to zero so that the ratio of the "within to between" is extraordinarily large and unstable. In these circumstances, the process for looking for outliers is repeated as above, except that the cut off level for examining the standardized residuals is dropped slightly, to 2.576 (for the within subject phase only), in addition, a graphical review is undertaken to assess these influential observations. The graphical review consists of plotting the differences against the means for each pair of recall and followup recall. This allows for the identification of records for which the mean of the repeat observations is close to the overall mean but for which there is a large difference between the repeat observations. Such an observation would contribute little to the between subject variability but would be a large component to the within subject variability thus contributing to the high ratio of within to between variability. These observations are removed as outliers in an effort to stabilise the variance components.

3 Usual Intakes from Food and Supplements

During the BCNS, information on intakes of vitamin and mineral supplements was collected for both the day of the food recall as well as the ususal intake over the past month. For each of these time spans, the DIN of the supplement was collected wherever possible as well as the number of doses and the size of a single dose. This allowed nutrients to be assigned very specifically to the reported supplements using the new NSS data entry system and the Therapeutic Products Program current Drug Product Database (DPD).

Ideally, one would like to take the nutrient intake from supplements and food sources on the recall day and apply the same procedure as outlined above to estimate usual intake from all sources However, there are two features of supplement intake which makes this method of adjustment difficult to apply to nutrient intakes from supplements or from food plus supplements. First, the distribution of a nutrient intake from supplements tends to consist of a combination of a mass function distribution at specific bolus doses and a distribution of non-specific doses. This makes it difficult to find a parsimonious transformation to form a smooth, symmetric distribution for the adjustment on any scale. The second problem is that nutrient intakes from supplements tend to be the same from one day to another for a large proportion of the population. This means that for these subjects there is little intra-person variability contributed by the supplement portion for consumers, whereas this portion adds tremendous inter-person variability making the variance components potentially very unstable unless some "binning" by supplement dose is considered . Some efforts were made in this direction and more work will be pursued in the longer term looking at alternative adjustment software as well.

However, an alternative approach was considered: could the food intake be adjusted as above, and the longer term estimate of supplement intake from the past month added to the food intake? In order that this be an appropriate approach, there were a number of methodological considerations: it is necessary that information is available that allows for the estimation of usual intakes from supplements and that the intakes from supplements are essentially uncorrelated with the intakes from foods. Both these issues are discussed in the following sections and discussed in more detail in **Methodology for Estimating Usual Intake of Micro-Nutrients from Food and Supplements**, (Hayward, (2003)).

Consider the following repeated measures model where the observed nutrient X has been transformed to Y by the function $\mathcal{T}$ (such as log for example) to the most appropriate analysis scale and outliers eliminated:

$$Y_{kG}^{fv} = \mu_G^{fv} + c_{G(k)}^{fv} + e_{Gk(f)}^{fv}, \qquad \text{... (8)}$$

The superscript '*fv*' indicates intakes from both food and vitamin and mineral supplements and in the following discussion a superscript of '*f*' alone indicates intakes from food and of '*v*' alone indicates intakes from vitamin and mineral supplements. This model is expressed in the same form as for intakes from food only in section 2. If everything was as we would like it, then we would assume the following,

$$c^{fv}_{G(k)} \sim N(0, \sigma^2_{B_{fv}}) \qquad e^{fv}_{Gk(f)} \sim N(0, \sigma^2_{W_{fv}})$$

but because of the behaviour of nutrient intakes from supplements only the weaker assumption of zero expectation will hold, i.e.

$$E(c^{fv}_{G(k)}) = E(e^{fv}_{Gk(f)}) = 0$$

$$\mathrm{var}(c^{fv}_{G(k)}) = \sigma^2_{B_{fv}}$$

and $$\mathrm{var}(e^{fv}_{Gk(f)}) = \sigma^2_{W_{fv}}$$

Now we would like to find an adjustment $Z(Y^{fv})$ such that

$$E(Z(Y^{fv})) = \mu^{fv}_{G}$$

and $$V(Z(Y^{fv})) = \sigma^2_{B_{fv}}$$

Consider the estimate of total food plus supplement intake for those that have a total of 2 recall estimates. If we separate the intakes in model 8 into two separate models, one for food and one for supplement intakes then we have the models:

$$Y^{f}_{kG} = \mu^{f}_{G} + c^{f}_{G(k)} + e^{f}_{Gk(f)} \qquad \text{...(9)}$$

and $$Y^{v}_{kG} = \mu^{v}_{G} + c^{v}_{G(k)} + e^{v}_{Gk(f)} \qquad \text{...(10)}$$

where

$$c^{f}_{G(k)} \sim N(0, \sigma^2_{B_f}) \quad e^{f}_{Gk(f)} \sim N(0, \sigma^2_{W_f})$$

$$E(c^{v}_{G(k)}) = E(e^{v}_{Gk(f)}) = 0$$

$$\mathrm{var}(c^{v}_{G(k)}) = \sigma^2_{B_v} \qquad \mathrm{var}(e^{v}_{Gk(f)}) = \sigma^2_{W_v}$$

Now if the

$$\mathrm{cov}(c^{f}_{G(k)}, c^{v}_{G(k)}) = 0$$

$$\mathrm{cov}(c^{f}_{G(k)}, e^{f}_{Gk(f)}) = 0$$

$$\mathrm{cov}(c^{v}_{G(k)}, e^{v}_{Gk(f)}) = 0$$

and $$\mathrm{cov}(e^{f}_{Gk(f)}, e^{v}_{Gk(f)}) = 0$$

then, if we can find adjustments $Z(Y^f)$ and $Z(Y^v)$ such that

$$E(Z(Y^f)) \sim \mu_G^f \qquad V(Z(Y^f)) \sim \sigma_{B_f}^2$$

$$E(Z(Y^v)) \sim \mu_G^v \qquad V(Z(Y^v)) \sim \sigma_{B_v}^2$$

we can estimate $Z(Y^{fv})$ by the sum $Z(Y^f) + Z(Y^v)$.

The adjustment for nutrient intakes from food as described in section 2 satisfies the requirements for $Z(Y^f)$. If we use the longer term estimate of supplement intake from the past month for $Z(Y^v)$ then given that supplement use is consistent over time for a large proportion of the population and assuming that the recall of supplement use is reasonably accurate then the first requirement,

$$E(Z(Y^v)) \sim \mu_G^v$$

is satisfied and the variance can be expressed as

$$V(Z(Y^v)) \sim \sigma_{B_v}^2 + \frac{\sigma_{W_v}^2}{M}$$

Note: Previous studies have demonstrated that the intra-person variability of semi-quantitative food frequency responses is similar to that of the average of responses from a multiple number of days of food recalls (Liu (1994), Sempos (1991)). However, little work has been done in the case of semi-quantitative supplement frequency responses. Fortunately, $\sigma_{W_v}^2$ is quite small and without specifying M in the above formula, we can use this variance estimate to illustrate that the contribution of $\sigma_{W_v}^2$ to the overall variance of $Z(Y^v)$ is small and further reduced by the factor M. Thus $V(Z(Y^v)) \sim \sigma_{B_v}^2$ and the second requirement for $Z(Y^v)$ is satisfied.

3.1 Supplement intake reporting and estimation of usual supplement intake

In order to assess how to characterize usual nutrient intakes from supplements it was necessary to investigate the pattern of reported supplement use from the yesterday recalls as well as the frequency of supplement use reported in the past month. The following table, 3.1.1, summarizes patterns of supplement use between the two 24 hour (yesterday) recalls for all persons with two recalls.

Table 3.1.1. Comparison of two day supplement recalls

nutrient	Participants with a repeat 24 hour recall: Comparison of 2 day supplement recalls			
	% not reporting supplements on either day	% reporting supplements on only 1 of 2 days	* % reporting supplements on both days	concordance of dose for those reporting on both days (i.e. col *)
folic acid	68%	7%	24%	88%
pantothenic acid	73%	7%	20%	90%
riboflavin	68%	8%	24%	91%
thiamin	68%	8%	24%	91%
vitamin B6	67%	8%	26%	89%
vitamin B12	69%	8%	24%	89%
vitamin C	57%	9%	34%	82%
vitamin A	69%	6%	25%	87%
calcium	61%	8%	31%	80%
magnesium	70%	7%	23%	82%
phosphorous	81%	5%	14%	94%
potassium	79%	5%	16%	89%
iron	75%	6%	19%	90%
zinc	71%	9%	21%	90%

Most people reported no nutrient intake from supplements on either day (57% to 81%). Five to nine percent reported nutrient intake from supplements on only one of the two days and 14% to 31% reported nutrient intakes on both days. Although the number reporting nutrient intakes from supplements on only one day is less than 10% for all nutrients, this accounts for approximately 1/4 of those who reported nutrient intakes from supplements on one or both days. A high percentage of those who reported intakes from supplements for the various nutrients on both days, reported the same intakes for both days (80% to 94%). Thus, the within subject variability, $\sigma_{W_i}^2$, is extremely small (approaching zero) for 80% to 90% of the population. This leaves a small percentage with any day to day difference to estimate of which, as noted, approximately 1/4 did not report intakes on one of the two days. This gives inconsistent within subject variability making it difficult to estimate appropriately.

The following table, 3.1.2, summarizes patterns of supplement use between the first 24 hour (yesterday) recall and the monthly supplement frequency recall for all first recalls.

Table 3.1.2. **Comparison of yesterday and monthly supplement report.**

	Compare yesterday and monthly supplement report: all 1^{st} recalls			
nutrient	no intake monthly or yesterday	monthly but no yesterday intake	* yesterday & monthly intakes	concordance of dose if intake reported both yesterday & monthly (i.e. col *)
folic acid	65%	8%	27%	66%
pantothenic acid	68%	8%	24%	64%
riboflavin	62%	9%	29%	66%
thiamin	63%	9%	28%	66%
vitamin B6	62%	9%	29%	65%
vitamin B12	63%	9%	28%	66%
vitamin C	51%	12%	37%	62%
vitamin A	63%	9%	28%	66%
calcium	57%	9%	34%	61%
magnesium	68%	7%	25%	65%
phosphorous	80%	5%	15%	68%
potassium	77%	6%	18%	68%
iron	73%	7%	20%	63%
zinc	69%	7%	23%	65%

It can be seen that approximately two thirds of the daily intakes for users, as reported on the monthly recalls, were the same as the first recall intakes. This suggests that there is a high proportion of supplement users who take supplements regularly and thus provide a good estimate of usual supplement intake in their monthly recall. In the absence of a method for adjusting the reported intakes from the 24hr recalls, the monthly recall provides an alternative. The degree of accuracy of the reported monthly intakes for the remaining one third of users, for which reported monthly intakes were different from the first recall intakes, will vary but as this corresponds to approximately 10% of the total population of respondents, it is felt that this will have a minor impact on the overall distributions of nutrient intakes.

3.2 Correlation of supplement intake and combining intakes from food and supplements

A method has been developed to adjust the bivariate distribution of two nutrients which removes the intra-subject correlation as well as the intra-subject variability of each individual nutrient (Hayward, 2003, *in progress*) but it would be difficult to adapt this method to the nutrient intakes from foods and supplements for the same reasons it would be difficult to apply a univariate adjustment to nutrient intakes from supplements. However, if it can be shown that nutrient intakes from food have a small correlation with nutrient intakes from supplement use for supplement users then, as mentioned above, the usual intakes derived for food can be added to the usual intakes derived separately for nutrient intakes from supplements.

Correlations between nutrient intakes from food (first recall) and from supplements (monthly), users only, were determined for 8 age-sex groups and 14 micro-nutrients for the BC nutrient survey. These correlations were adjusted or deattenuated, by the method given in Rosner and Willett (1988), for the intra-subject variability of the food intakes. Of all these 8×14 correlations only six were significantly different from zero at the 5% level. Many of the correlations were quite small even after deattenuation and there was generally no consistent pattern of correlation across the age-sex groups. Thus, the nutrient intakes from supplements are essentially independent from nutrient intakes from food. Since there is no need to remove the intra-subject correlation the usual intakes from food and the supplements can be determined separately. By definition the usual intakes are free of intra-subject variability, thus the adjusted intakes from food, $Z(Y^f)$, and the usual intakes from supplements, $Z(Y^v)$, are distributed such that

$$E(Z(Y^f)) \sim \mu_G^f \qquad V(Z(Y^f)) \sim \sigma_{B_f}^2$$

$$E(Z(Y^v)) \sim \mu_G^v \qquad V(Z(Y^v)) \sim \sigma_{B_v}^2$$

and $\operatorname{cov}(Z(Y^f), Z(Y^v)) \sim 0$.

This takes care of the covariance of the between subject errors of food and supplements, $\operatorname{cov}(c_{G(k)}^f, c_{G(k)}^v)$. As for the two covariances of within subject errors with between subject errors across food and supplement intakes, $\operatorname{cov}(c_{G(k)}^f, e_{Gk(f)}^f)$ and $\operatorname{cov}(c_{G(k)}^v, e_{Gk(f)}^v)$, there is no postulated mechanism for an association of these errors and it is not expected that there would be a non-zero correlation . On the other hand, the covariance of the within subject errors of food and supplements, $\operatorname{cov}(e_{Gk(f)}^f, e_{Gk(f)}^v)$, may not be zero. This has not been investigated, however it should be small, especially since the within subject variability of supplement intakes is quite small for a large percentage of the population of supplement users, i.e ~ 0. This is an area of future research. Given the satisfaction of these conditions, the intakes remain uncorrelated when transforming back to the original scale and thus can be summed on this scale to arrive at a usual intake from both food and supplements.

3.3 Fixed effects

As in previous discussion, the fixed effects are collectively referred to by '*G*'. The fixed effects are chosen so that *G* defines an appropriate set of subpopulations for which the expected intakes,

$$E(Y_{kG}^{fv}) = \mu_G^{fv}$$

are correct for the comparisons that are made after adjusting for usual intakes. It was important to consider supplement use as one of the fixed effects in *G*, since for any comparison of subpopulations defined by supplement use, it was important that the expected intakes from food have the correct expectations for these subpopulations, whether the intake was from foods or from both food and supplements.

Investigation of supplement use indicated that it was a significant factor for many of the nutrient intakes from foods, whereas geographic stratum and/or season were often less significant. If supplement use is not included as a factor, then the adjusted food intakes will have expectations that fall in the middle of the separate expectations for each group defined by supplement use and the difference in food intakes between supplement users and non-users will be reduced. Therefore, it was desirable to include it as a factor in the ANOVA model when adjusting the food intakes. However, in order to maintain the stability of the adjustment procedure it was necessary to drop either geographic stratum or season from the model. Season was the first choice to drop since it was generally found to be not a significant factor for nutrient intakes from food, however it proved to be quite a significant factor for vitamin C. In the end a model including age/gender and geographic stratum along with supplement use as factors was used for all nutrients except vitamin C for which the model included season and not geographic stratum.

4. Results and Discussion

All of the published nutrients with the exception of alcohol, caffeine and carotene were adjusted using the method discussed previously for food intakes. Alcohol, caffeine and carotene were not included in the process because of the extreme shape of their distributions. A large percentage of their distributions were located at a single point (i.e., zero grams of the nutrient). Usual intakes from both food and supplements were determined only for those nutrients for which there was reported intakes from supplements.

Transformations were successfully identified after removing <5% of the data as outliers for the scale which provided the best fit. The transformation chosen for each nutrient is shown in Table 6.1.

After the initial estimation, there were extreme ratios of within/between variance components in at least one age-sex group, for sodium, vitamin A, iron, thiamin, potassium, niacin, linlenic acid, folacin and dietary folic equivalents. There were negative variance components in at least one age-sex group for % calories from protein, iron thiamin folic acid and vitamin C. After a graphical review, influential observations were identified for each nutrient. Removal of these influential individuals stabilized the variance components for all nutrients.

Cholesterol had nine observations with a value of "0" intake on the recall which results in missing values when a log transformation is used in the calculation of the adjusted intake. In these cases, the closest nutrient value from an individual in the same age-sex-season group was imputed for the calculation of adjusted intake only.

For the fourteen micro-nutrients commonly available in supplements, usual daily intakes were derived from the monthly recalls of supplement use. These were then added to the adjusted food intakes to provide a distribution of usual intakes from both food and supplements.

Table 6.1 provides the estimates of the inter and the intra individual variability, as well as the ratio of the "within variance to between variance" and the adjusted value R. Figures 7.1 - 7.9 illustrate the effect of the adjustment process by plotting the distribution of the single day observed intake and the adjusted distribution for percent calories from the macro nutrients, dietary fibre, cholesterol and energy. These graphs demonstrate that the adjusted distribution has the same shape and median as the original variable, but that the tails on either side have been reduced. Figures 7.10 - 7.14 illustrate the effect of the adjustment process for both food and supplements for the micro-nutrients vitamin C, zinc, magnesium, thiamin and dietary folate equivalents. The contribution of supplements can be seen in the distributions for vitamin C, zinc, thiamin and the dietary folate equivalents as extra bumps (modes) in the right tail of the distribution. Zinc provides a good illustration of the effect of including supplement use as one of the adjustment factors when adjusting food intake. The effect can be seen as an increase in the separation of the distributions around the main, or food only, mode and the secondary mode which corresponds to a specific dose of supplement intake for the females. The dietary folate equivalent intakes are interesting in that they show pronounced modes for two doses of folic acid intake which do not show in the distribution for the males.

5. References

Beaton, Milner, Corey, McGuire, Cousins, Stewart, de Ramos, Hewitt, Grambsch, Kassim, Little(1979) Sources of variation in 24 hour dietary recall data: implications for nutrition study design and interpretation. American Journal of Clinical Nutrition vol 32, pp2546-2559.

Beaton, Milner, McGuire, Feather, Little (1983) "Source of variation in 24 hour dietary recall data: implications for nutrition study design and interpretation. Carbohydrate sources, vitamins and minerals." American Journal of Clinical Nutrition vol 37, pp 986-995.

Cochran, W. (1977) Sampling Techniques. John Wiley & Sons.

D'Agostino, R.B. and Stephens, M.A. (1986) Goodness-of-fit techniques New York:Marcel Dekker, Inc.

Hayward, S. (2003 *in progress*) Methodology for Estimating Usual Intake of Micro-Nutrients from Food and Supplements, #??, Bureau of Biostatistics and Computer Applications, Food Directorate, Health Canada.

Karpinski, K. and Nargundkar, M. (1992) Nova Scotia Nutrition Survey Methodology Report. Technical Document #E451311-001, Bureau of Biostatistics and Computer Applications, Food Directorate, Health Canada.

Liu, K. Stamler, J., Dyer, A., McKeever, J. and McKeever, P. (1978) "Statistical methods to assess and minimize the role of intra-individual variability in obscuring the relationship between dietary lipids and serum cholesterol." Journal of Chronic Diseases vol 31, pp 399-415.

Liu, K. (1994) "Statistical issues related to semiquantitative food-frequency questionnaires." American Journal of Clinical Nutrition vol 59(suppl), pp 262S-265S.

National Center for Health Statistics (1994) Consensus workshop on Dietary Assessment: Nutrition Monitoring and Tracking the Year 2000 Objectives. Maryland: US Department of Health and Human Services.

National Research Council. (1986) Nutrient Adequacy. National Academy Press, pp 16-25.

Rust, K., and Rao, J.N.K. (1996) "Variance estimation for complex surveys using replication techniques". Methods in Medical Research, vol 5, pg 283-310.

Searle, S., Casella, G., and McCulloch, C. (1992) Variance Components. New York: John Wiley & Sons

Sempos, C.T. (1991) "Invited commentary: Some limitations of semiquantitative food-frequency questionnaires." American Journal of Epidemiology, v ol 135, pp 1127-1132.

Snedecor, G., and Cochran, W.(1980) Statistical Methods (7th ed.). Ames: Iowa State University Press.

Steele, R.G.D and Torrie, J.H. (1960) Principles and Procedures of Statistics with Special Reference to Biological Sciences. New York: McGraw Hill.

Thompson, J.N. (1990) CANDI: Canadian Dietary Information System, Project E311-213, Nutrition Research Division, Food Directorate, Sir F.G. Banting Research Centre, Health Protection Branch, Canada, Ottawa, K1A 0L2.

Nguyen, L., Junkins, B. (2001) BC Nutrition Survey 1996- Analysis of Nonresponse. Bureau of Biostatistics and Computer Applications, Food Directorate Health Canada Technical Report E451311-008NR.

6. Tables

Table 6.1 Variance Components

Nutrient (transformation)	pooled age-sex group	within component	between component	ratio of within/between	adjustment factor R
% energy from lipids	M 18-34	62.4245	12.1441	5.14031	0.40356
	M 35-54	57.6402	13.8155	4.17213	0.43971
	M 55-74	31.0570	33.2226	0.93481	0.71892
	M 75-85	41.4214	27.2860	1.51805	0.63019
	F 18-34	52.9895	22.7915	2.32497	0.54841
	F 35-54	57.0946	29.6022	1.92873	0.58433
	F 55-74	55.7389	27.2352	2.04658	0.57292
	F 75-85	38.4408	23.4850	1.63683	0.61583
% energy from carbohydrates	M 18-34	89.9815	23.6953	3.79744	0.45656
	M 35-54	43.1073	58.2888	0.73955	0.75820
	M 55-74	29.1867	59.9265	0.48704	0.82005
	M 75-85	55.2771	40.2847	1.37216	0.64927
	F 18-34	61.5273	30.8872	1.99200	0.57812
	F 35-54	82.4517	19.8296	4.15800	0.44031
	F 55-74	68.3055	37.2050	1.83592	0.59382
	F 75-85	52.1776	34.6757	1.50473	0.63186
% energy from saturates (√)	M 18-34	0.2783	0.0867	3.20956	0.48740
	M 35-54	0.2687	0.0959	2.80184	0.51287
	M 55-74	0.2176	0.1882	1.15616	0.68102
	M 75-85	0.1460	0.2411	0.60549	0.78922
	F 18-34	0.2966	0.1394	2.12817	0.56540
	F 35-54	0.3088	0.1536	2.01016	0.57638
	F 55-74	0.2649	0.2005	1.32136	0.65634
	F 75-85	0.2206	0.1909	1.15548	0.68113
% energy from monosaturates	M 18-34	15.5354	2.2821	6.80755	0.35788
	M 35-54	14.4981	2.3202	6.24864	0.37143
	M 55-74	7.4526	7.9471	0.93777	0.71837
	M 75-85	11.0134	4.5040	2.44525	0.53875
	F 18-34	14.8440	2.4305	6.10730	0.37510
	F 35-54	15.6901	4.6402	3.38136	0.47774
	F 55-74	11.0088	7.2639	1.51554	0.63050
	F 75-85	9.2792	5.2078	1.78179	0.59957
% energy from polyunsaturates (∛)	M 18-34	0.0238	0.0035	6.82003	0.35760
	M 35-54	0.0173	0.0103	1.67732	0.61115
	M 55-74	0.0139	0.0139	0.99907	0.70727

Nutrient (transformation)	pooled age-sex group	within component	between component	ratio of within/between	adjustment factor R
	M 75-85	0.0139	0.0095	1.46392	0.63707
	F 18-34	0.0202	0.0038	5.39472	0.39545
	F 35-54	0.0185	0.0117	1.58511	0.62196
	F 55-74	0.0186	0.0101	1.83524	0.59389
	F 75-85	0.0150	0.0135	1.10866	0.68865
total energy (√)	M 18-34	46.8258	67.8106	0.69054	0.76911
	M 35-54	53.2503	22.7683	2.33880	0.54727
	M 55-74	21.0692	41.1541	0.51196	0.81326
	M 75-85	24.7985	19.2530	1.28804	0.66110
	F 18-34	49.5601	12.3025	4.02845	0.44595
	F 35-54	31.1940	20.1890	1.54510	0.62683
	F 55-74	16.7642	21.0548	0.79621	0.74614
	F 75-85	28.1535	10.2927	2.73529	0.51741
cholesterol (log)	M 18-34	0.3322	0.2948	1.12673	0.68572
	M 35-54	0.3879	0.1076	3.60591	0.46595
	M 55-74	0.30411	0.29846	1.01893	0.70378
	M 75-85	0.38590	0.18171	2.12371	0.56580
	F 18-34	0.47009	0.23907	1.96634	0.58062
	F 35-54	0.40886	0.15440	2.64811	0.52356
	F 55-74	0.53194	0.06547	8.12502	0.33104
	F 75-85	0.42729	0.10947	3.90335	0.45160
% energy from protein (log)	M 18-34	0.05881	0.03970	1.48157	0.63480
	M 35-54	0.04282	0.03249	1.31772	0.65686
	M 55-74	0.05435	0.01947	2.79142	0.51357
	M 75-85	0.04417	0.03279	1.34686	0.65276
	F 18-34	0.06635	0.03173	2.09127	0.56876
	F 35-54	0.06934	0.02936	2.36156	0.54542
	F 55-74	0.06931	0.01145	6.05358	0.37653
	F 75-85	0.05105	0.00991	5.15234	0.40316

Nutrient (transformation)	pooled age-sex group	within component	between component	ratio of within/between	adjustment factor R
Sodium ($\sqrt[4]{}$)	M 18-34	0.62942	0.29097	2.16317	0.56226
	M 35-54	0.69404	0.19437	3.57075	0.46774
	M 55-74	0.41962	0.41520	1.01064	0.70523
	M 75-85	0.36975	0.23074	1.60245	0.61988
	F 18-34	0.40302	0.23015	1.75112	0.60290
	F 35-54	0.34573	0.30798	1.12255	0.68639
	F 55-74	0.40632	0.15814	2.56947	0.52930
	F 75-85	0.47365	0.10545	4.49182	0.42672
total fibre ($\sqrt[4]{}$)	M 18-34	0.06587	0.01641	4.01519	0.44654
	M 35-54	0.05407	0.02555	2.11593	0.56651
	M 55-74	0.02737	0.04655	0.58790	0.79357
	M 75-85	0.03601	0.03207	1.12306	0.68631
	F 18-34	0.04546	0.01783	2.55009	0.53074
	F 35-54	0.03539	0.03493	1.01320	0.70478
	F 55-74	0.02956	0.03639	0.81240	0.74280
	F 75-85	0.06204	0.01177	5.26861	0.39941
vitamin C ($\sqrt[4]{}$)	M 18-34	0.50669	0.05921	8.55772	0.32346
	M 35-54	0.21389	0.31663	0.67552	0.77255
	M 55-74	0.25579	0.17320	1.47681	0.63541
	M 75-85	0.29952	0.06980	4.29139	0.43473
	F 18-34	0.45331	0.11525	3.93309	0.45024
	F 35-54	0.29654	0.10989	2.69850	0.51998
	F 55-74	0.22405	0.12246	1.82956	0.59448
	F 75-85	0.15797	0.18614	0.84864	0.73548
vitamin A (log)	M 18-34	0.56990	0.09257	6.15667	0.37380
	M 35-54	0.26603	0.25145	1.05799	0.69707
	M 55-74	0.47361	0.17110	2.76800	0.51516
	M 75-85	0.39143	0.30025	1.30367	0.65885
	F 18-34	0.44882	0.20104	2.23246	0.55620
	F 35-54	0.55744	0.22916	2.43257	0.53975
	F 55-74	0.53408	0.08311	6.42605	0.36696
	F 75-85	0.51615	0.05521	9.34811	0.31086

Nutrient (transformation)	pooled age-sex group	within component	between component	ratio of within/between	adjustment factor R
zinc ($\sqrt[4]{\ }$)	M 18-34	0.03063	0.02118	1.44648	0.63934
	M 35-54	0.04108	0.01318	3.11629	0.49289
	M 55-74	0.01806	0.02169	0.83293	0.73863
	M 75-85	0.02180	0.01448	1.50502	0.63182
	F 18-34	0.028583	0.004894	5.83996	0.38236
	F 35-54	0.026630	0.011358	2.34473	0.54679
	F 55-74	0.021672	0.010284	2.10737	0.56729
	F 75-85	0.021348	0.009430	2.26392	0.55352
iron ($\sqrt[4]{\ }$)	M 18-34	0.050277	0.015239	3.29929	0.48228
	M 35-54	0.033572	0.019721	1.70229	0.60832
	M 55-74	0.015798	0.016234	0.97318	0.71190
	M 75-85	0.020149	0.010713	1.88069	0.58918
	F 18-34	0.034297	0.008126	4.22083	0.43765
	F 35-54	0.022756	0.015308	1.48650	0.63417
	F 55-74	0.019050	0.013878	1.37266	0.64921
	F 75-85	0.025316	0.004693	5.39466	0.39545
vitamin B12 ($\sqrt[4]{\ }$)	M 18-34	0.043596	0.031136	1.40017	0.64547
	M 35-54	0.066985	0.020441	3.27693	0.48354
	M 55-74	0.029982	0.032134	0.93302	0.71925
	M 75-85	0.038311	0.020833	1.83898	0.59350
	F 18-34	0.042845	0.013010	3.29312	0.48263
	F 35-54	0.040217	0.013485	2.98233	0.50111
	F 55-74	0.032653	0.013108	2.49112	0.53520
	F 75-85	0.031363	0.012331	2.54339	0.53124
vitamin B6 ($\sqrt{\ }$)	M 18-34	0.077805	0.048114	1.61709	0.61815
	M 35-54	0.087787	0.014841	5.91499	0.38028
	M 55-74	0.044747	0.039022	1.14671	0.68252
	M 75-85	0.040524	0.020829	1.94557	0.58266
	F 18-34	0.068557	0.011141	6.15336	0.37389
	F 35-54	0.057206	0.019254	2.97112	0.50181
	F 55-74	0.034085	0.032522	1.04805	0.69876
	F 75-85	0.035113	0.026737	1.31330	0.65748

Nutrient (transformation)	pooled age-sex group	within component	between component	ratio of within/between	adjustment factor R
thiamin ($\sqrt[4]{}$)	M 18-34	0.023380	0.005066	4.61489	0.42202
	M 35-54	0.020670	0.002983	6.92879	0.35514
	M 55-74	0.007470	0.009679	0.77182	0.75126
	M 75-85	0.010735	0.001242	8.64631	0.32197
	F 18-34	0.012922	0.008927	1.44749	0.63920
	F 35-54	0.013903	0.003507	3.96470	0.44880
	F 55-74	0.009144	0.005379	1.69986	0.60860
	F 75-85	0.013409	0.001532	8.75510	0.32017
riboflavin ($\sqrt[4]{}$)	M 18-34	0.007096	0.015061	0.47118	0.82445
	M 35-54	0.011201	0.004716	2.37523	0.54431
	M 55-74	0.005237	0.007523	0.69618	0.76783
	M 75-85	0.008725	0.003443	2.53446	0.53191
	F 18-34	0.012038	0.003734	3.22386	0.48657
	F 35-54	0.008687	0.004662	1.86327	0.59097
	F 55-74	0.006871	0.004197	1.63714	0.61579
	F 75-85	0.005458	0.005998	0.91001	0.72357
protein ($\sqrt[4]{}$)	M 18-34	0.055413	0.077320	0.71667	0.76323
	M 35-54	0.074322	0.028637	2.59526	0.52739
	M 55-74	0.042767	0.055780	0.76670	0.75235
	M 75-85	0.041277	0.028185	1.46451	0.63699
	F 18-34	0.065723	0.023273	2.82402	0.51138
	F 35-54	0.070053	0.013268	5.27994	0.39905
	F 55-74	0.0390	0.0288	1.35626	0.65146
	F 75-85	0.0501	0.0174	2.87902	0.50774
potassium ($\sqrt{}$)	M 18-34	98.3454	77.5063	1.26887	0.66389
	M 35-54	81.0078	48.2016	1.68060	0.61078
	M 55-74	41.4236	64.1470	0.64576	0.77950
	M 75-85	34.3456	47.0199	0.73045	0.76019
	F 18-34	90.5973	12.3561	7.33218	0.34643
	F 35-54	69.7490	27.5315	2.53342	0.53199
	F 55-74	39.9063	51.0318	0.78199	0.74911
	F 75-85	41.5723	38.6627	1.07526	0.69417

Nutrient (transformation)	pooled age-sex group	within component	between component	ratio of within/between	adjustment factor R
phosphorous ($\sqrt[4]{\ }$)	M 18-34	0.2653	0.3214	0.82525	0.74018
	M 35-54	0.3397	0.0527	6.44189	0.36657
	M 55-74	0.1375	0.2271	0.60534	0.78925
	M 75-85	0.1573	0.1200	1.31035	0.65790
	F 18-34	0.3068	0.0509	6.03008	0.37716
	F 35-54	0.2161	0.0779	2.77452	0.51472
	F 55-74	0.1228	0.1892	0.64917	0.77870
	F 75-85	0.1791	0.1332	1.34526	0.65299
pantothenic acid ($\sqrt[4]{\ }$)	M 18-34	0.0233	0.0145	1.60850	0.61916
	M 35-54	0.0229	0.0044	5.14871	0.40328
	M 55-74	0.0078	0.0172	0.45483	0.82907
	M 75-85	0.0115	0.0076	1.49885	0.63260
	F 18-34	0.0193	0.0049	3.94460	0.44971
	F 35-54	0.0137	0.0127	1.07118	0.69485
	F 55-74	0.0087	0.0100	0.86941	0.73139
	F 75-85	0.0121	0.0062	1.94985	0.58224
niacin ($\sqrt[4]{\ }$)	M 18-34	0.0396	0.0621	0.63711	0.78156
	M 35-54	0.0489	0.0216	2.25994	0.55385
	M 55-74	0.0270	0.0291	0.92802	0.72019
	M 75-85	0.0289	0.0140	2.05978	0.57168
	F 18-34	0.0478	0.0085	5.65217	0.38772
	F 35-54	0.0403	0.0106	3.79590	0.45663
	F 55-74	0.0307	0.0189	1.62299	0.61745
	F 75-85	0.0315	0.0152	2.08065	0.56974
magnesium ($\sqrt[4]{\ }$)	M 18-34	0.1206	0.0997	1.20957	0.67274
	M 35-54	0.1758	0.0286	6.15386	0.37388
	M 55-74	0.0688	0.0917	0.75051	0.75582
	M 75-85	0.0799	0.0667	1.19839	0.67445
	F 18-34	0.1199	0.0295	4.06187	0.44447
	F 35-54	0.1044	0.0581	1.79601	0.59804
	F 55-74	0.0635	0.0934	0.68055	0.77139
	F 75-85	0.1070	0.0303	3.53636	0.46951

Nutrient (transformation)	pooled age-sex group	within component	between component	ratio of within/between	adjustment factor R
linoleic acid ($\sqrt[4]{\ }$)	M 18-34	0.0573	0.0241	2.37611	0.54424
	M 35-54	0.0596	0.0318	1.87377	0.58989
	M 55-74	0.0303	0.0461	0.65679	0.77690
	M 75-85	0.0364	0.0265	1.37609	0.64874
	F 18-34	0.0524	0.0173	3.02185	0.49864
	F 35-54	0.0593	0.0135	4.38506	0.43093
	F 55-74	0.0429	0.0143	2.99710	0.50018
	F 75-85	0.0388	0.0146	2.65975	0.52273
linlenic acid ($\sqrt[4]{\ }$)	M 18-34	0.0237	0.01908	1.24412	0.66754
	M 35-54	0.0259	0.01846	1.40376	0.64499
	M 55-74	0.0186	0.02931	0.63608	0.78180
	M 75-85	0.0248	0.01242	1.99795	0.57755
	F 18-34	0.0365	0.00995	3.66528	0.46298
	F 35-54	0.0389	0.00915	4.25346	0.43629
	F 55-74	0.0333	0.00673	4.95053	0.40994
	F 75-85	0.0283	0.00612	4.61517	0.42201
folacin ($\sqrt[4]{\ }$)	M 18-34	0.2794	0.06439	4.33931	0.43277
	M 35-54	0.1884	0.07566	2.49064	0.53524
	M 55-74	0.0891	0.13598	0.65519	0.77728
	M 75-85	0.1436	0.01970	7.29088	0.34730
	F 18-34	0.1994	0.03201	6.22969	0.37191
	F 35-54	0.1297	0.12278	1.05593	0.69742
	F 55-74	0.1263	0.08538	1.47929	0.63509
	F 75-85	0.1116	0.06828	1.63398	0.61616
dietary folate equivalents ($\sqrt[4]{\ }$)	M 18-34	0.3749	0.06332	5.92095	0.38012
	M 35-54	0.2173	0.08847	2.45621	0.53790
	M 55-74	0.1099	0.16939	0.64901	0.77873
	M 75-85	0.1408	0.03143	4.47993	0.42718
	F 18-34	0.2521	0.03488	7.22903	0.34860
	F 35-54	0.1747	0.12963	1.34744	0.65268
	F 55-74	0.1494	0.08798	1.69788	0.60882
	F 75-85	0.1220	0.06249	1.95310	0.58192

Nutrient (transformation)	pooled age-sex group	within component	between component	ratio of within/between	adjustment factor R
folic acid ($\sqrt[4]{}$)	M 18-34	0.3846	0.06701	5.73974	0.38519
	M 35-54	0.3612	0.08494	4.25252	0.43633
	M 55-74	0.2376	0.20545	1.15627	0.68100
	M 75-85	0.1794	0.08555	2.09709	0.56823
	F 18-34	0.3138	0.06222	5.04398	0.40676
	F 35-54	0.3570	0.06631	5.38319	0.39580
	F 55-74	0.2523	0.06996	3.60652	0.46592
	F 75-85	0.2091	0.04691	4.45693	0.42808
natural folate (log)	M 18-34	0.2131	0.13201	1.61399	0.61851
	M 35-54	0.1430	0.11143	1.28375	0.66172
	M 55-74	0.1117	0.10543	1.05982	0.69676
	M 75-85	0.1345	0.08293	1.62133	0.61764
	F 18-34	0.2468	0.03343	7.38154	0.34541
	F 35-54	0.1238	0.16505	0.75036	0.75585
	F 55-74	0.1426	0.11877	1.20072	0.67409
	F 75-85	0.1277	0.10343	1.23458	0.66896
carbohydrates ($\sqrt{}$)	M 18-34	10.5752	7.80288	1.35529	0.65160
	M 35-54	7.3534	6.21547	1.18308	0.67681
	M 55-74	3.0620	5.69667	0.53750	0.80648
	M 75-85	4.3496	2.45560	1.77132	0.60070
	F 18-34	8.5861	1.24156	6.91561	0.35543
	F 35-54	6.1602	2.42123	2.54423	0.53118
	F 55-74	4.1568	2.59518	1.60175	0.61996
	F 75-85	5.2249	1.08909	4.79749	0.41532
calcium ($\sqrt[4]{}$)	M 18-34	0.3574	0.40572	0.88088	0.72915
	M 35-54	0.2626	0.25513	1.02916	0.70201
	M 55-74	0.21688	0.27415	0.79108	0.74721
	M 75-85	0.16922	0.21148	0.80018	0.74532
	F 18-34	0.32759	0.23115	1.41721	0.64319
	F 35-54	0.34535	0.16475	2.09619	0.56831
	F 55-74	0.17386	0.28228	0.61591	0.78667
	F 75-85	0.15087	0.22923	0.65815	0.77658

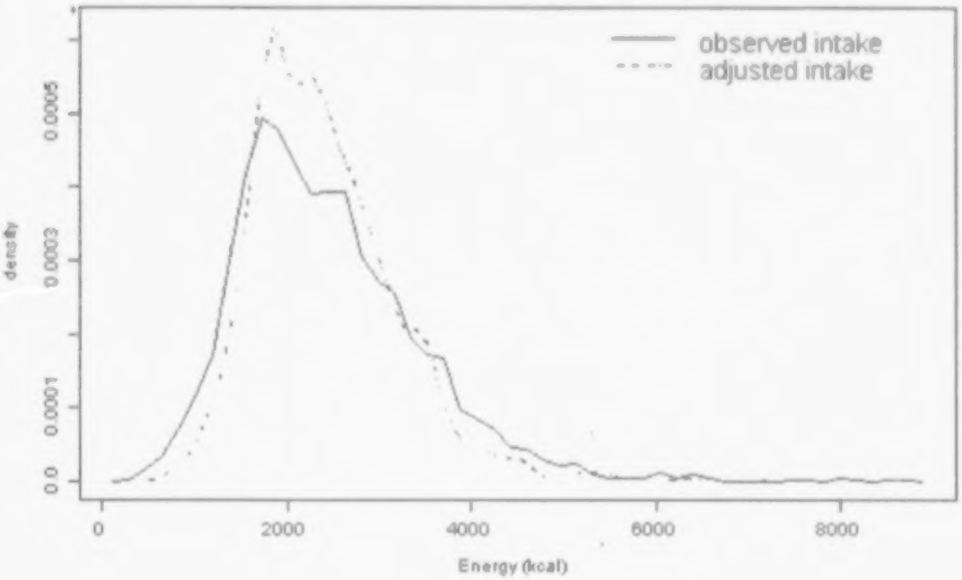
Nutrient (transformation)	pooled age-sex group	within component	between component	ratio of within/between	adjustment factor R
lipids ($\sqrt{}$)	M 18-34	2.96732	3.29151	0.90151	0.72519
	M 35-54	3.24763	1.22435	2.65254	0.52324
	M 55-74	1.62193	2.59758	0.62440	0.78461
	M 75-85	1.88155	1.54451	1.21822	0.67143
	F 18-34	2.65983	1.52738	1.74143	0.60396
	F 35-54	2.30122	1.57631	1.45988	0.63759
	F 55-74	1.80640	1.18131	1.52916	0.62880
	F 75-85	1.58536	0.95199	1.66531	0.61253
total monosaturates ($\sqrt[4]{}$)	M 18-34	0.06097	0.05557	1.09727	0.69052
	M 35-54	0.07913	0.01241	6.37562	0.36821
	M 55-74	0.03650	0.06021	0.60624	0.78903
	M 75-85	0.04536	0.03593	1.26255	0.66481
	F 18-34	0.07153	0.02584	2.76815	0.51515
	F 35-54	0.05941	0.02657	2.23543	0.55595
	F 55-74	0.04450	0.03277	1.35804	0.65121
	F 75-85	0.04479	0.03002	1.49208	0.63346
total polunsaturates ($\sqrt[4]{}$)	M 18-34	0.05438	0.03588	1.51560	0.63049
	M 35-54	0.05635	0.03094	1.82117	0.59537
	M 55-74	0.03581	0.03937	0.90967	0.72364
	M 75-85	0.03623	0.02393	1.51433	0.63065
	F 18-34	0.04913	0.02038	2.41030	0.54151
	F 35-54	0.04884	0.02328	2.09785	0.56816
	F 55-74	0.03580	0.02516	1.42248	0.64250
	F 75-85	0.02892	0.02872	1.00715	0.70585
total saturates ($\sqrt[4]{}$)	M 18-34	0.04955	0.05940	0.83403	0.73841
	M 35-54	0.05946	0.02942	2.02078	0.57536
	M 55-74	0.04798	0.05421	0.88507	0.72834
	M 75-85	0.02849	0.06341	0.44929	0.83066
	F 18-34	0.07049	0.03592	1.96220	0.58102
	F 35-54	0.04881	0.04330	1.12729	0.68563
	F 55-74	0.05293	0.03861	1.37086	0.64945
	F 75-85	0.04312	0.03465	1.24427	0.66752

Graphs of Usual and One Day Distributions:

Figure 7.1 Energy: Males and Females
Figure 7.2 Percent Calories from Carbohydrate: Males and Females
Figure 7.3 Percent Calories from Protein: Males and Females
Figure 7.4 Percent Calories from Lipids: Males and Females
Figure 7.5 Percent Calories from Saturated Fat: Males and Females
Figure 7.6 Percent Calories from Monounsaturated Fat: Males and Females
Figure 7.7 Percent Calories from Polyunsaturated Fat: Males and Females
Figure 7.8 Cholesterol (mg): Males and Females
Figure 7.9 Dietary Fibre (g): Males and Females

Figure 7.1
BC Observed vs. Adjusted Intake
Energy: Males and Females

BC Males - Observed vs. Adjusted Intake



BC Females - Observed vs. Adjusted Intake

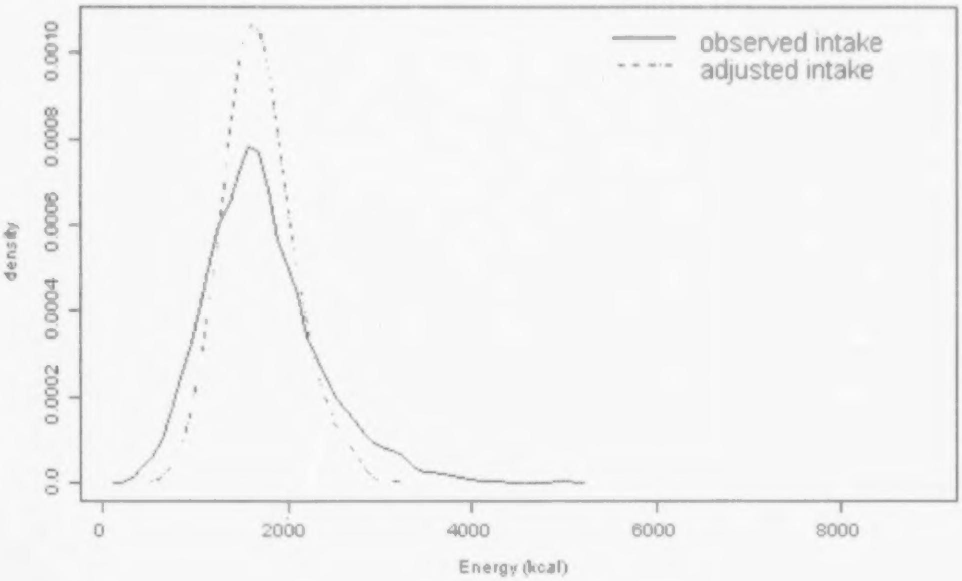
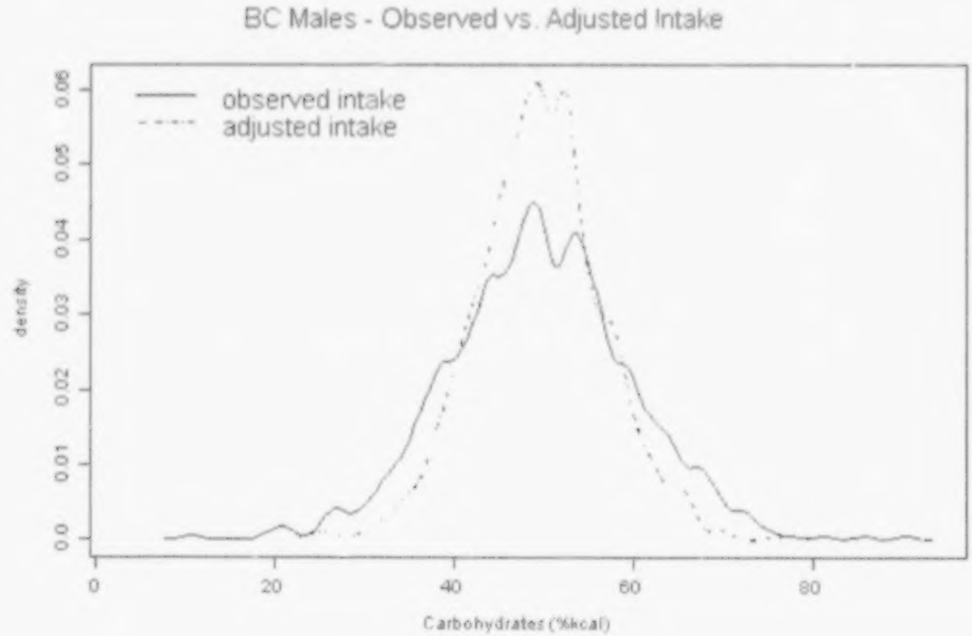
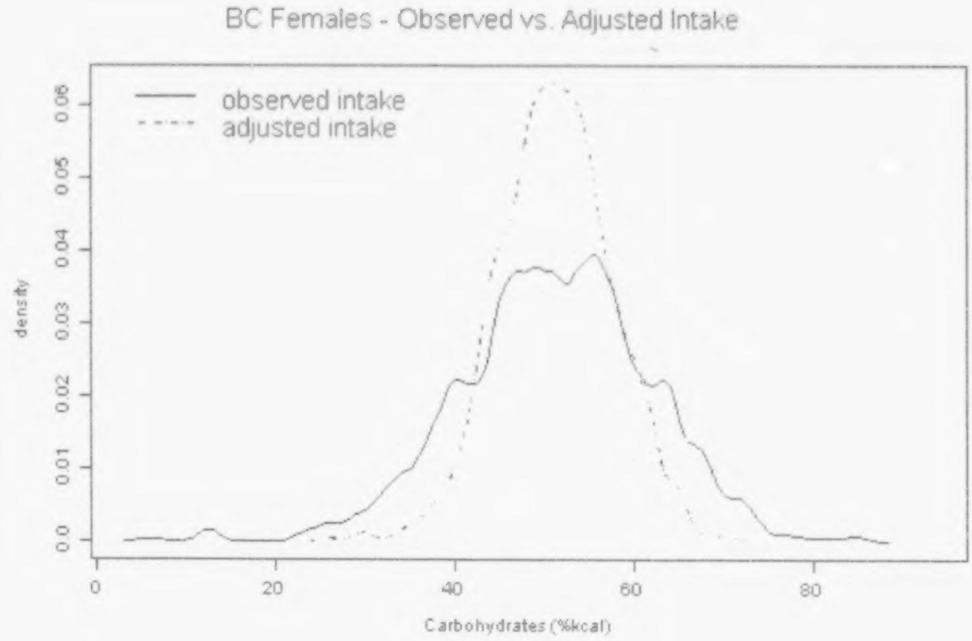


Figure 7.2
BC Observed vs. Adjusted Intake
Percent Calories from Carbohydrate: Males and Females



BC Males - Observed vs. Adjusted Intake



BC Females - Observed vs. Adjusted Intake

Figure 7.3
BC Observed vs. Adjusted Intake
Percent Calories from Protein: Males and Females

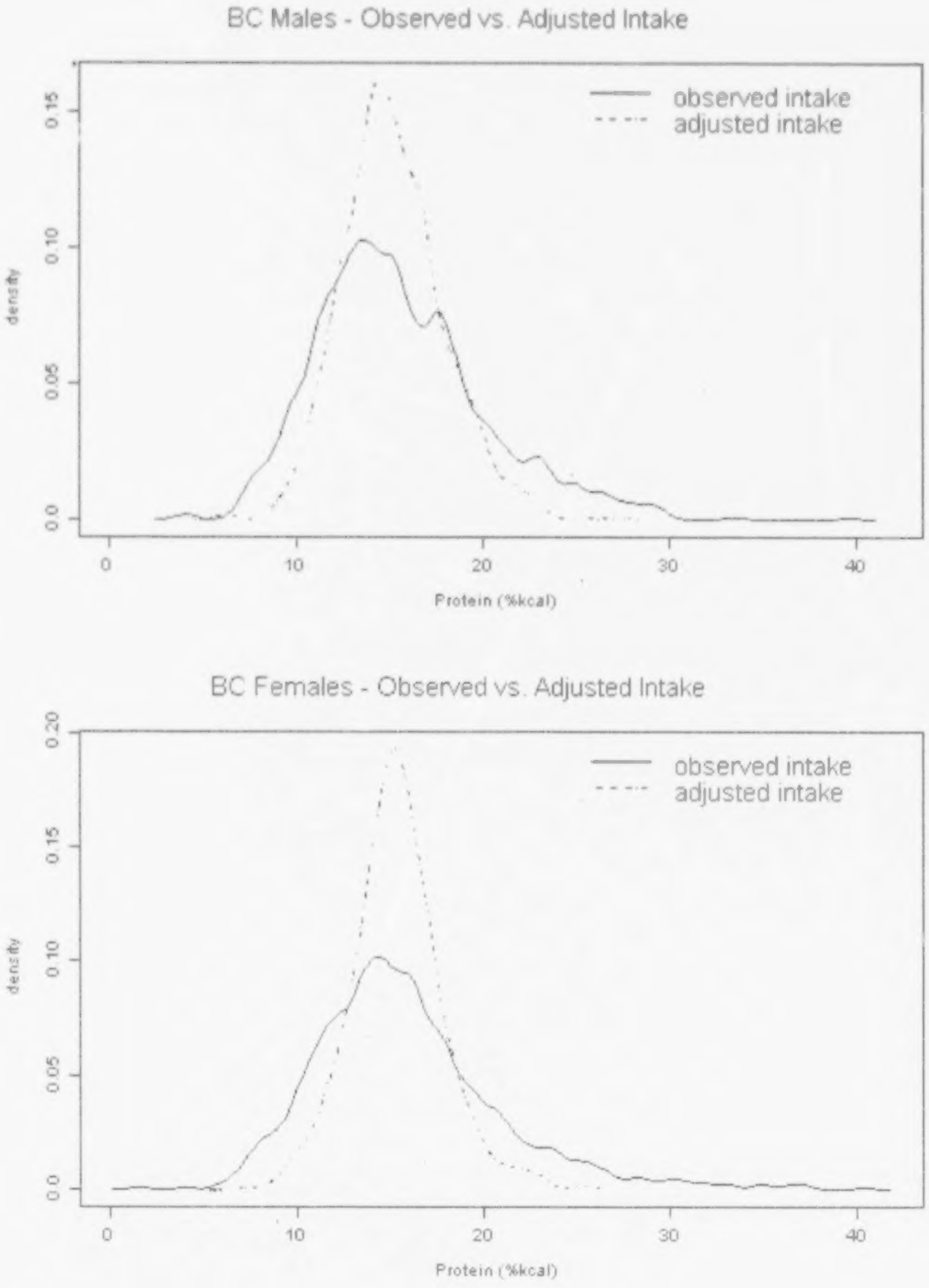


Figure 7.4
BC Observed vs. Adjusted Intake
Percent Calories from Lipids: Males and Females

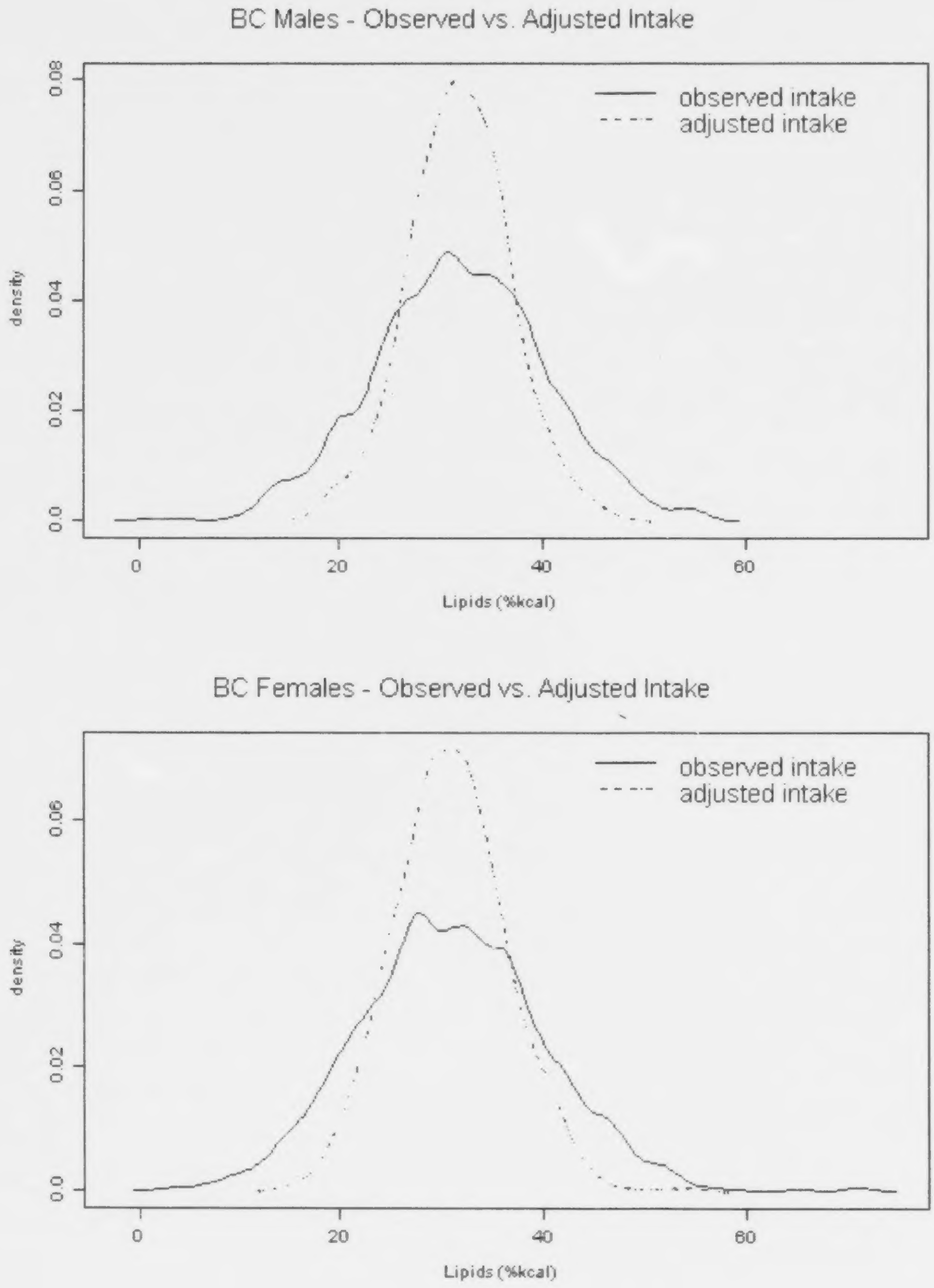
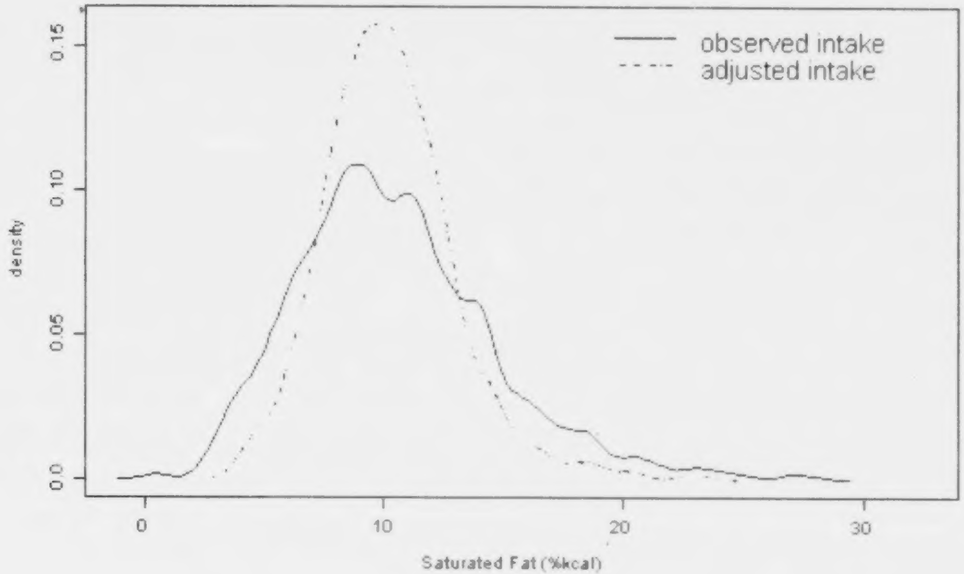


Figure 7.5
BC Observed vs. Adjusted Intake
Percent Calories from Saturated Fat: Males and Females

BC Males - Observed vs. Adjusted Intake



BC Females - Observed vs. Adjusted Intake

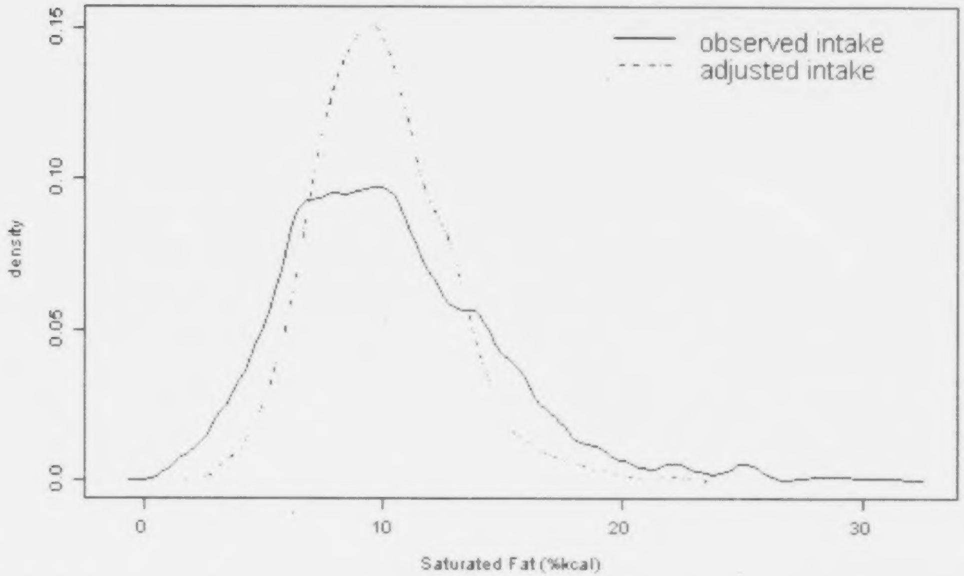
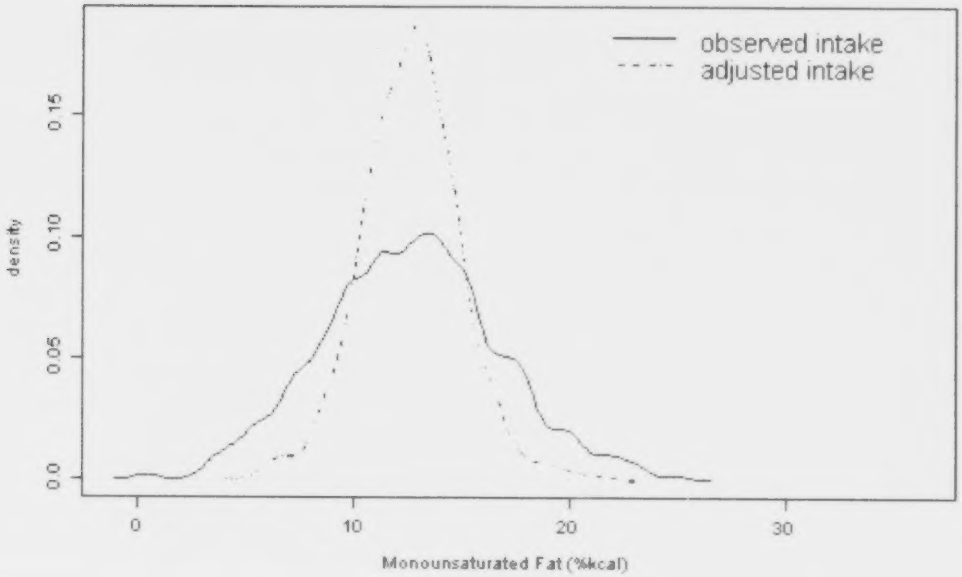


Figure 7.6
BC Observed vs. Adjusted Intake
Percent Calories from Monounsaturated Fat: Males and Females

BC Males - Observed vs. Adjusted Intake



BC Females - Observed vs. Adjusted Intake

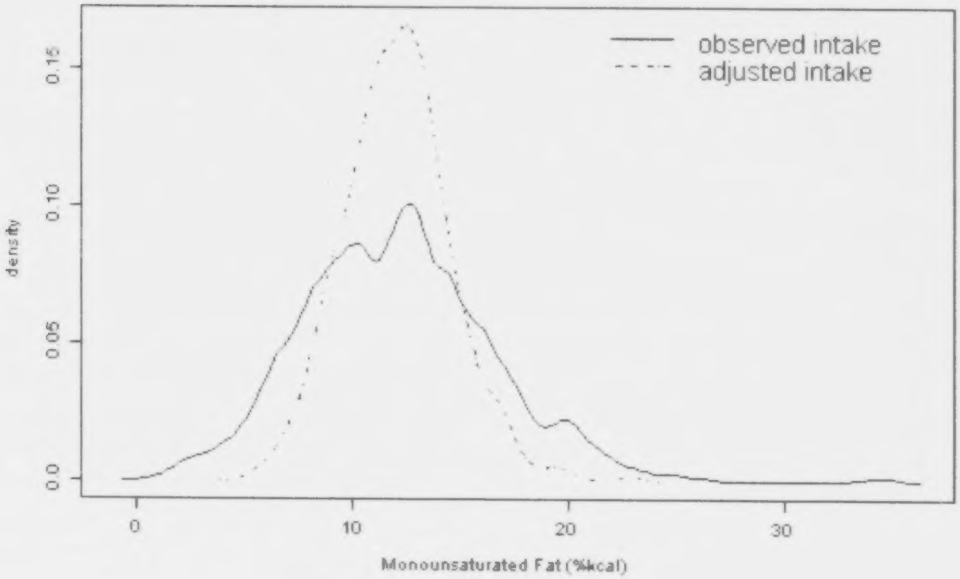
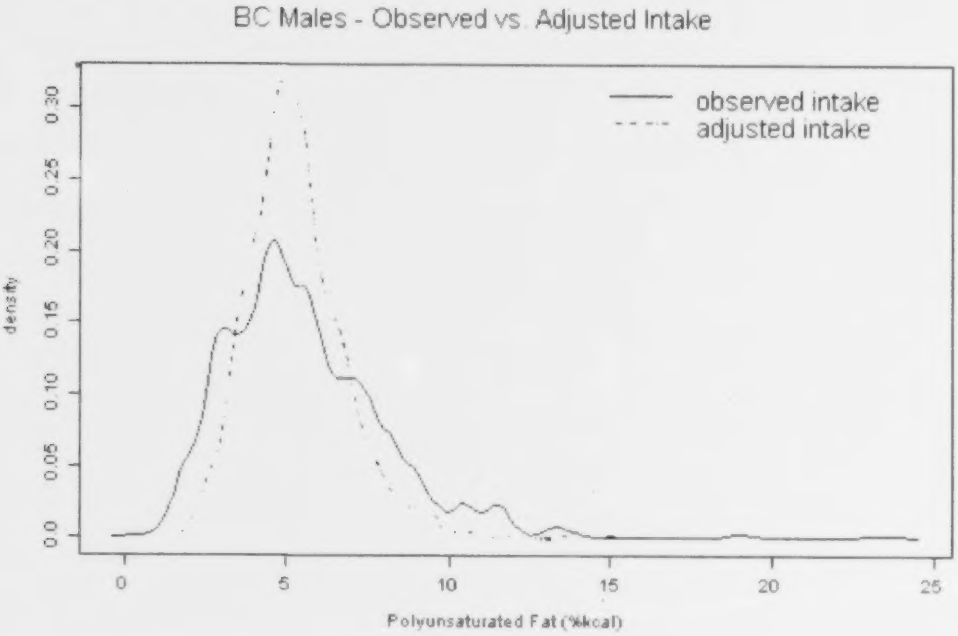


Figure 7.7
BC Observed vs. Adjusted Intake
Percent Calories from Polyunsaturated Fat: Males and Females


BC Males - Observed vs. Adjusted Intake

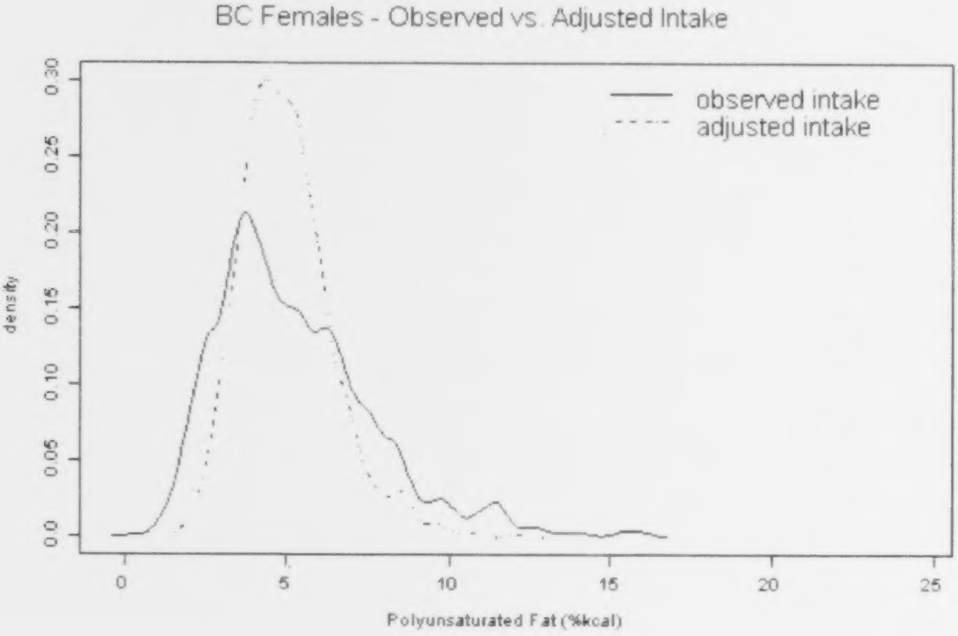
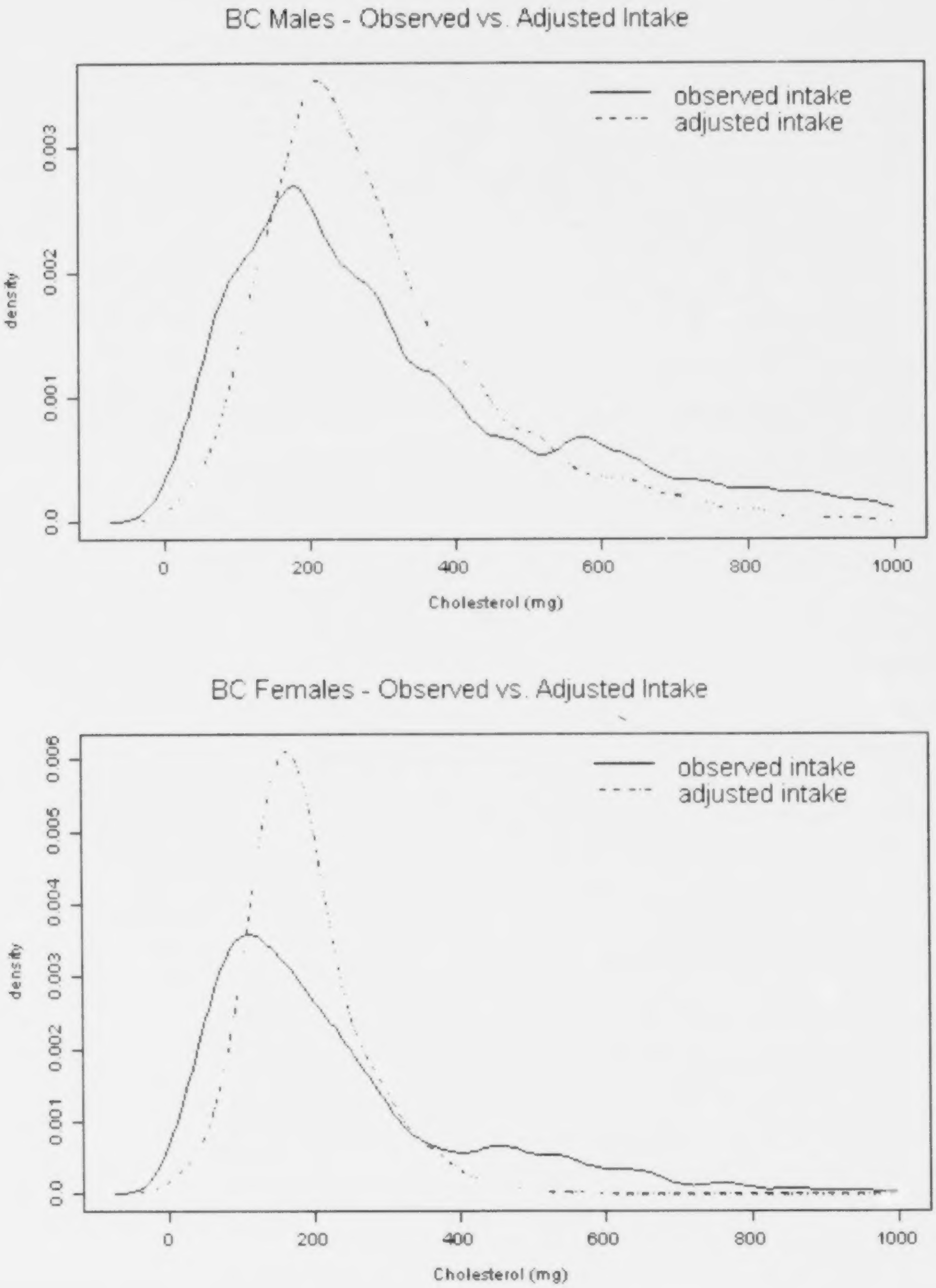

BC Females - Observed vs. Adjusted Intake

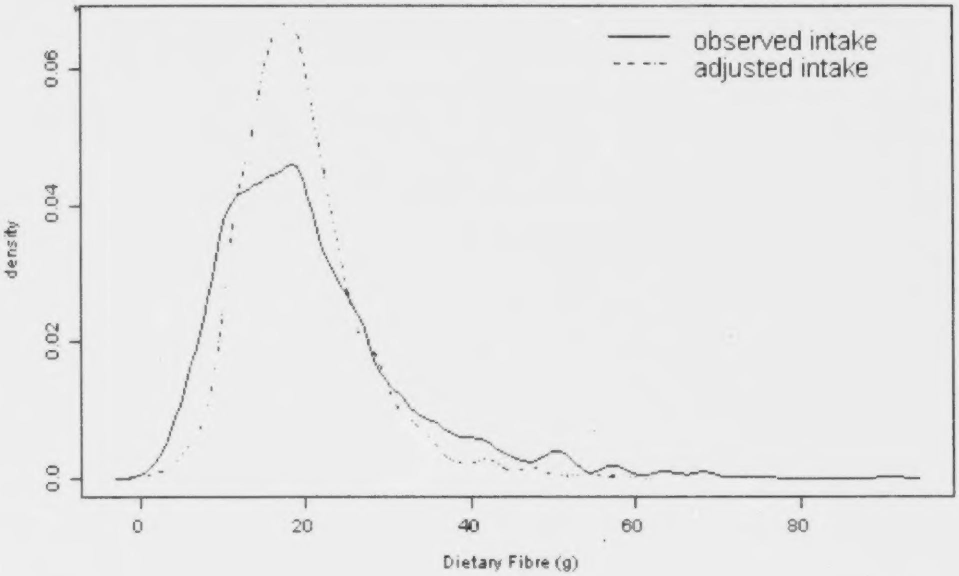
Figure 7.8
BC Observed vs. Adjusted Intake
Cholesterol (mg): Males and Females


BC Males - Observed vs. Adjusted Intake

BC Females - Observed vs. Adjusted Intake

Figure 7.9
BC Observed vs. Adjusted Intake
Dietary Fibre(g): Males and Females

BC Males - Observed vs. Adjusted Intake



BC Females - Observed vs. Adjusted Intake

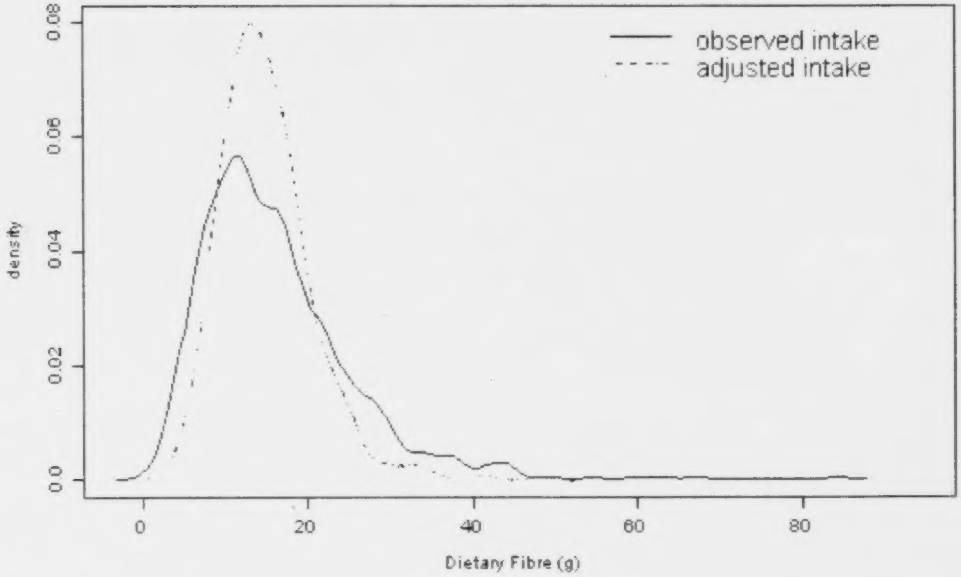
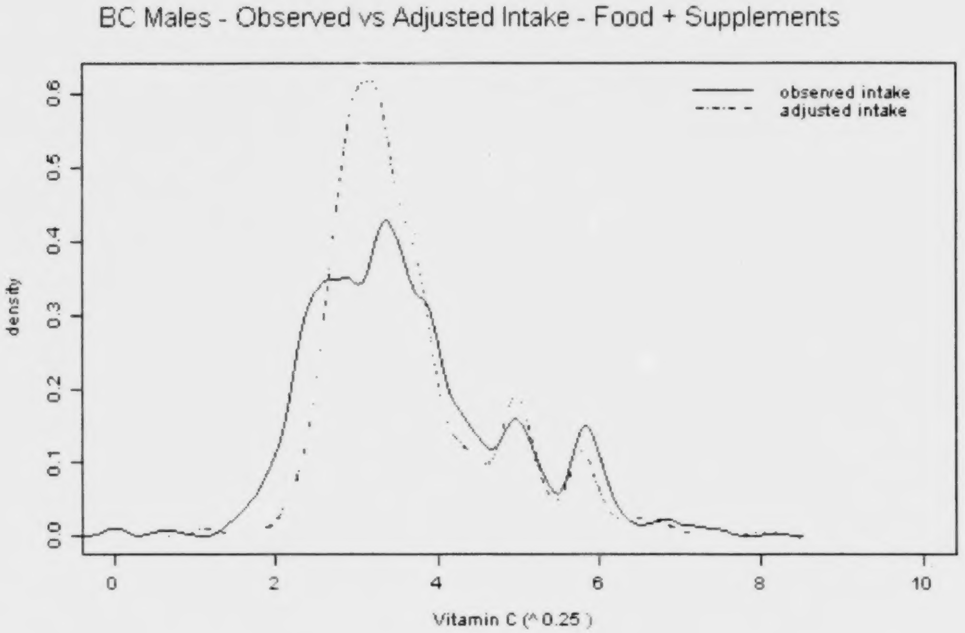


Figure 7.10
BC Observed vs. Adjusted Intake from Food and Supplements
Vitamin C (mg): Males and Females



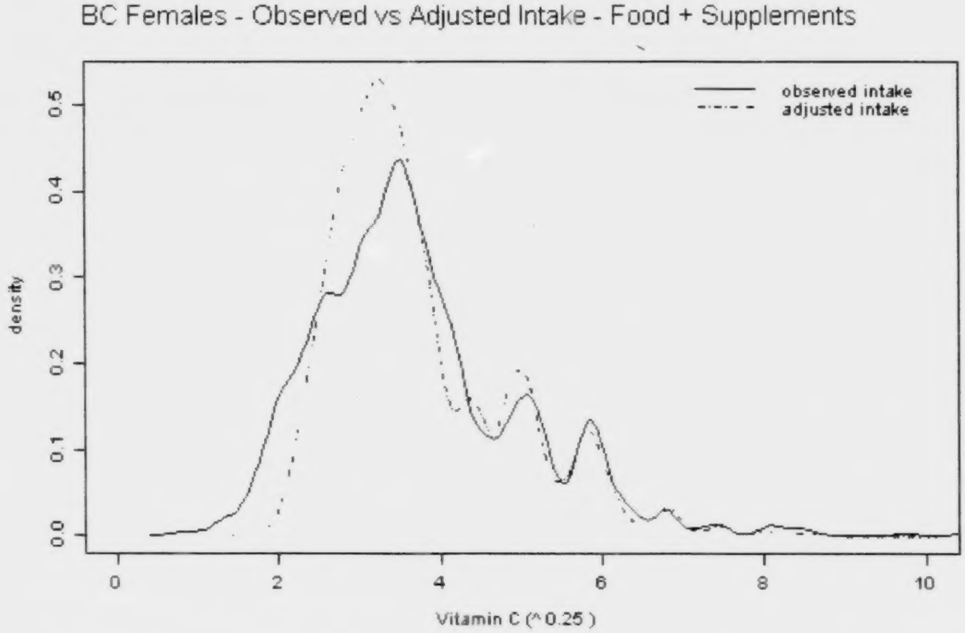
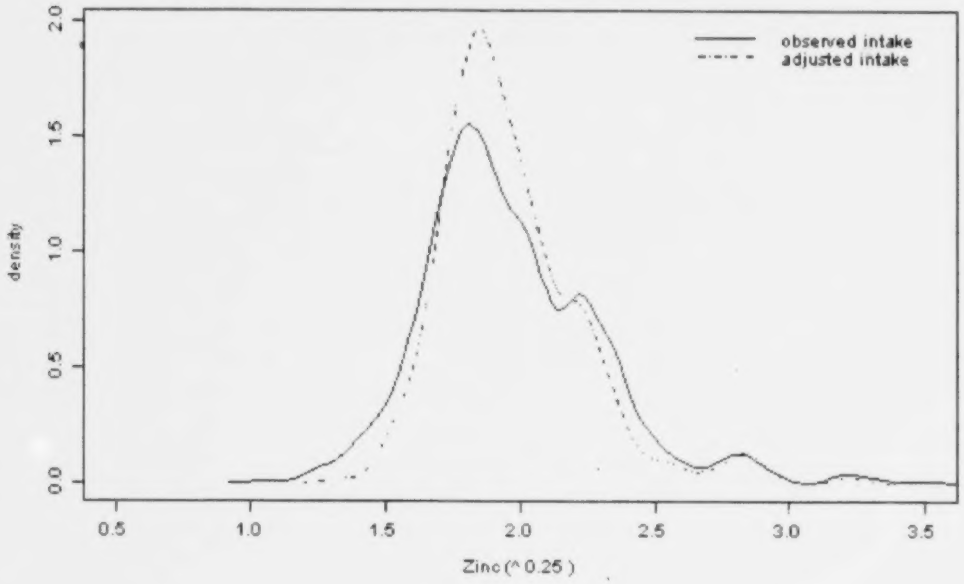
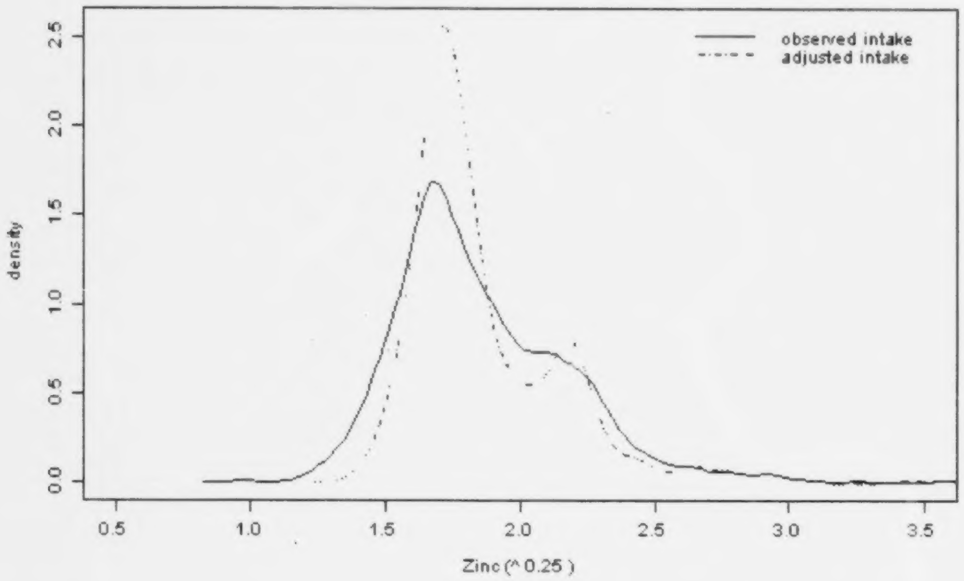


Figure 7.11
BC Observed vs. Adjusted Intake from Food and Supplements
Zinc (mg): Males and Females

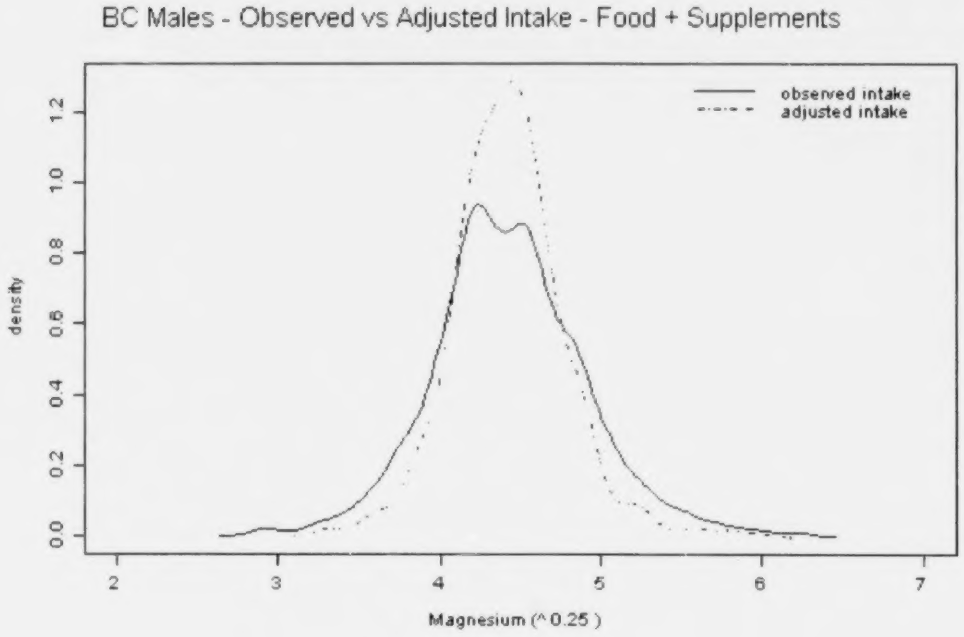


BC Males - Observed vs Adjusted Intake - Food + Supplements

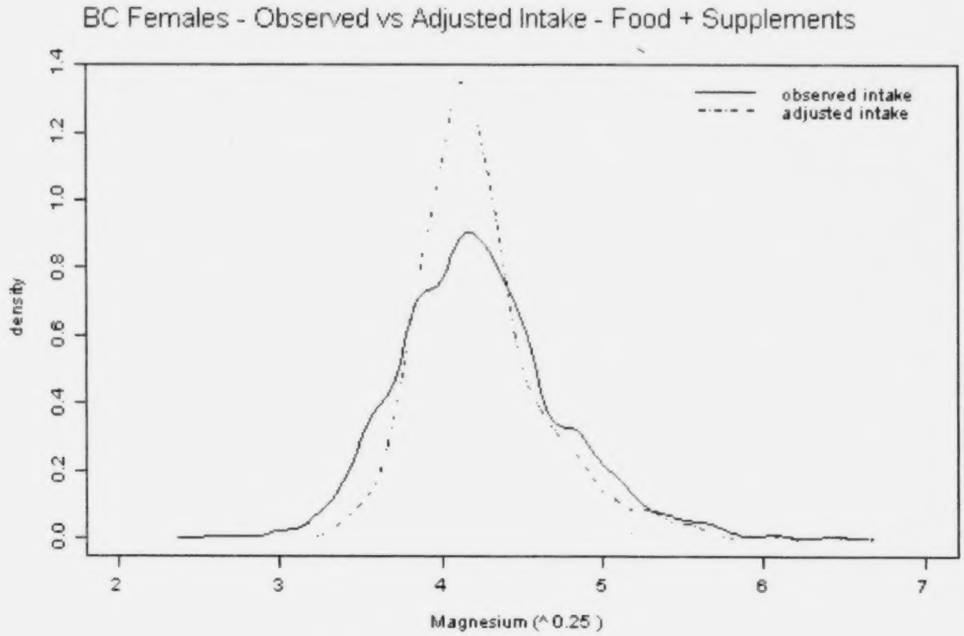


BC Females - Observed vs Adjusted Intake - Food + Supplements

Figure 7.12
BC Observed vs. Adjusted Intake from Food and Supplements
Magnesium (mg): Males and Females

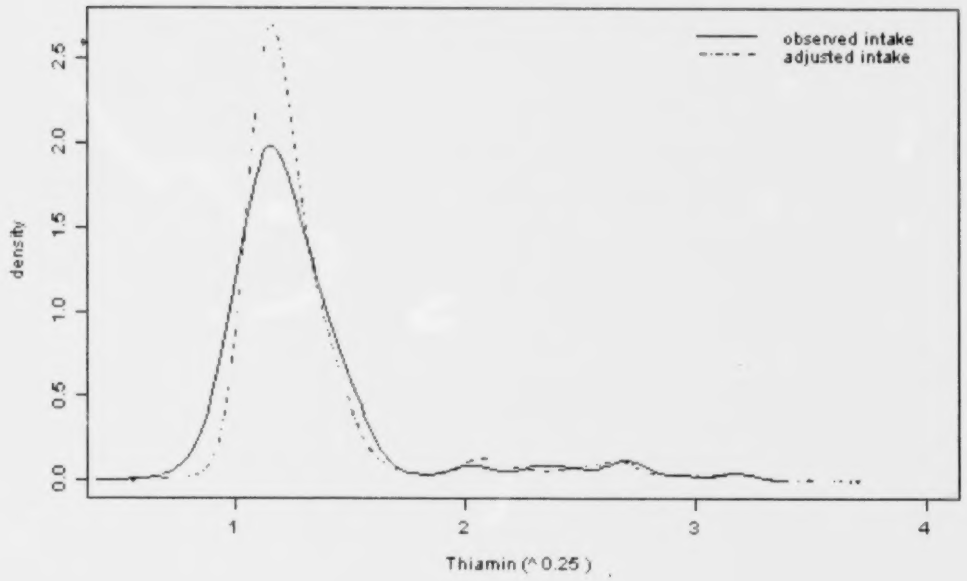


BC Males - Observed vs Adjusted Intake - Food + Supplements

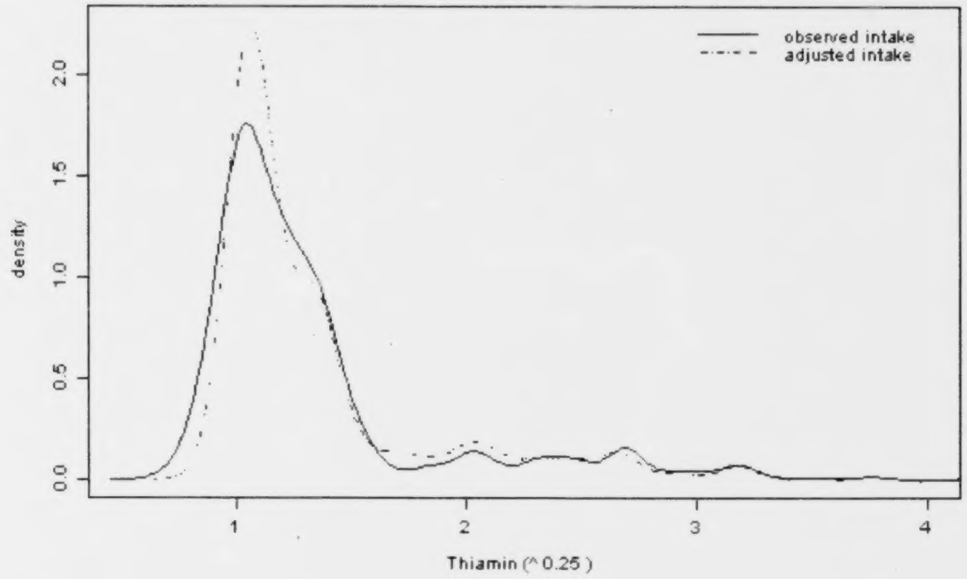


BC Females - Observed vs Adjusted Intake - Food + Supplements

Figure 7.13
BC Observed vs. Adjusted Intake from Food and Supplements
Thiamin (mg): Males and Females

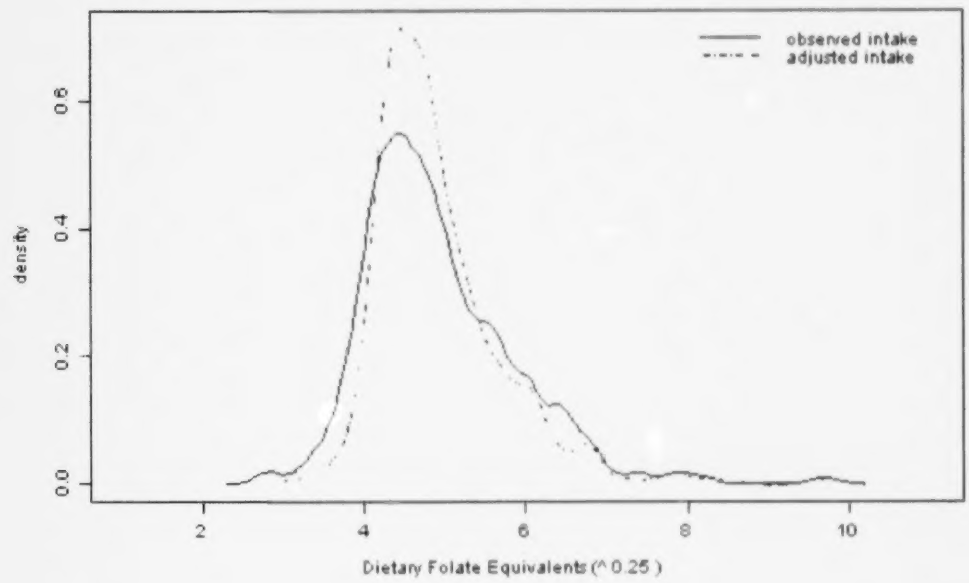


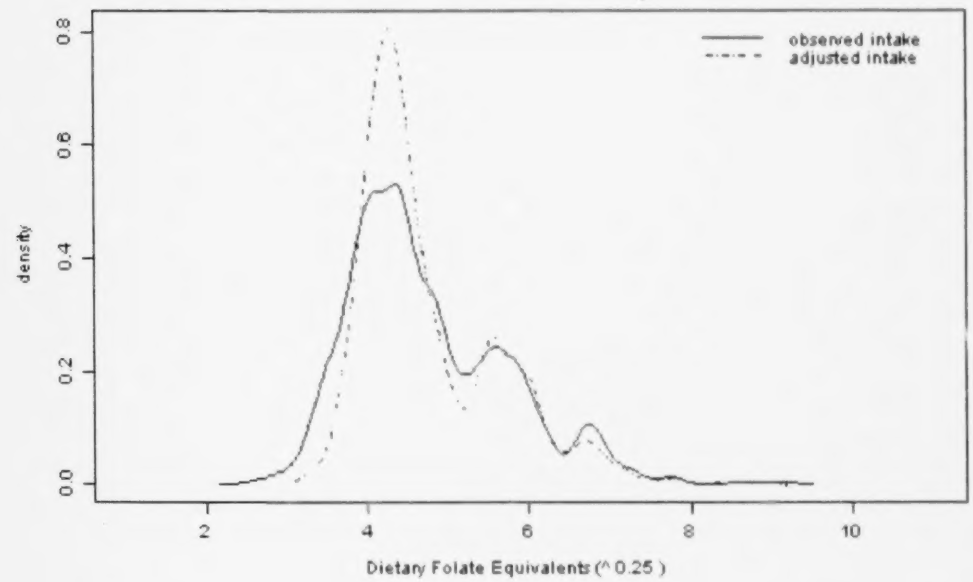
BC Males - Observed vs Adjusted Intake - Food + Supplements



BC Females - Observed vs Adjusted Intake - Food + Supplements

Figure 7.14
BC Observed vs. Adjusted Intake from Food and Supplements
Dietary Folate Equivalents: Males and Females


BC Males - Observed vs Adjusted Intake - Food + Supplements


BC Females - Observed vs Adjusted Intake - Food + Supplements

Appendix M

Probability of Inadequate Iron Intakes in British Columbia Iron Obtained from Foods Only

Probability of Inadequate Iron Intakes in British Columbia

Iron Obtained from Foods only

(Please note that in September 2002, the Bureau of Biostatistics and Computer Applications (BBCA) performed an analysis, similar to that contained in this report, of the probability of inadequate iron intakes from food source using the first version of the BCADJFDX data. Errors were subsequently found in the data and a second version was released in January 2003. The current analysis uses the second version of the BCADJFDX data, and is intended to replace the previous analysis)

The EAR cutpoint method is an appropriate short cut method where the underlying assumptions are met (Carriquiry (1999), FNB (2000)). This is the case for most nutrients considered but with some notable exceptions including iron. In the case of iron, the assumption that the requirement distribution be symmetric is not met, since this is known to be skewed for menstruating women (FNB(2000), page 51). For nutrients such as iron, the short cut EAR method cannot be used, and a more detailed mathematical treatment is need. The method used in this case is often termed "the full probability approach" where the full distributions of requirement and intake are used to estimate the probability that individuals with a particular intake would not meet their requirement. (FNB (1986)). This approach has been used historically to assess iron (Anderson *et. al* (1982)).

The analysis presented here uses the full probability approach but has expanded the methodology to allow a number of uncertainty factors to be included in the estimation: specifically, uncertainty around the fraction of oral contraceptive (OC) users and uncertainty around the distribution of iron intakes due to sampling. As noted in the FNB (2001) the distribution of requirements is significantly influenced by OC use and needs to be considered in arriving at an estimated requirements distribution for the population. In these calculations, the proportions of self reported OC users are estimated from the 136 and 300 BC respondents aged 19-30 and 31-49, respectively, who were healthy and not pregnant. These two samples are extracted from the 1998-1999 National Population Health Survey (NPHS) conducted by Statistics Canada (*For more information about NPHS 1998-1999 see http://www.statcan.ca/english/IPS/Data/82F0068XIE.htm*). Uncertainty in these proportions is characterized by the 95$^{\text{th}}$% confidence interval calculated taking the complex survey design of the NPHS into effect, using the specialized variance estimation software SUDAAN. The distribution of iron intakes is estimated from usual food consumption of 1821 BC respondents aged 19-84 who responded to the BC Nutrition Survey. Uncertainty around the intake distribution is characterized using the 95th% confidence intervals for percentiles of the distribution accounting for the stratified sample design of the BC Nutrition Survey, again using SUDAAN.

The expanded probability method uses a two dimensional Monte Carlo simulation to propagate the uncertainties through the probability approach and the results are presented below. (A technical document will be available providing more details about the techniques used and comparing this approach with alternatives.)

Table 1

Weighted Fraction of Oral Contraceptive Users * and its 95% Confidence Interval in Adults Aged 19-49

Age group	Sample size	Weighted Mean	95% Lower Limit	95% Upper Limit
Female, 19-30	136	0.261	0.187	0.335
Female, 31-49	300	0.102	0.068	0.136

* The weighted fraction of OC users and its 95% CI are estimated from the 1998-1999 National Population Health Survey (NPHS) data collected by Statistics Canada (*For more information about NPHS 1998-1999 see http://www.statcan.ca/english/IPS/Data/82F0068XIE.htm*).

Table 2

Estimated Percent of BC Population With Iron Intakes Below Requirement Including Uncertainty in OC Fraction and Intake Distribution

Estimated Percent BC Population Below Requirement (lower 95th CL, upper 95th CL)					
F 19-30 (n*=176) (%)	F 31-49 (n*=244) (%)	F 50 and over (n*=534) (%)	M 19-30 (n*=142) (%)	M 31-50 (n*=194) (%)	M 50 and over (n*=531) (%)
14.00 (12.82 –15.37)	19.71 (18.23 – 21.34)	1.43 (0.93 - 2.29)	0 (0 – 0.08)	0.02 (0 – 0.24)	0.98 (0.45 – 1.83)

References

Anderson, G.H. Peterson, R.D. and Beaton, G.H.(1982) "Estimating nutrient deficiencies in a population from dietary records: the use of probability analyses", *Nutr. Res.* **2**, 409-415.

Carriquiry, A.L. (1999) "Assessing the prevalence of nutrient inadequacy", *Pub. Health Nutr.* **2**, 23-33

Food and Nutrition Board, NRC (1986) *Nutrient Adequacy: Assessment Using Food Consumption Surveys*, National Academy Press: Washington.

Food and Nutrition Board, Institute of Medicine(2000) *Dietary Reference Intakes: Applications in Dietary Assessment*. National Academy Press: Washington

Food and Nutrition Board, Institute of Medicine(2001) *Dietary Reference Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium and Zinc* National Academy Press: Washington

Appendix N

Probability of Inadequate Iron Intakes in British Columbia Iron Obtained from Foods and Supplements

iron_food_and_suppl_v2 .doc Loan Nguyen & B. Junkins, Mar 20, 2003

Probability of Inadequate Iron Intakes in British Columbia

Iron Obtained from Foods And Supplements

(Please note that in November 2002, the Bureau of Biostatistics and Computer Application (BBCA) performed an analysis, similar to that contained in this report, of the probability of inadequate iron intakes from food and supplement source using the first version of the BCADJFDSUX data. Errors were subsequently found in the data and a second version was released in January 2003. The current analysis uses the second version of the BCADJFDSUX data, and is intended to replace the previous analysis.)

1. Methodology

The EAR cutpoint method is an appropriate shortcut method where the underlying assumptions are met (Carriquiry (1999), FNB (2000)). This is the case for most nutrients considered but with some notable exceptions including iron. In the case of iron, the assumption that the requirement distribution be symmetric is not met, since this is known to be skewed for menstruating women (FNB(2000), page 51). For nutrients such as iron, the shortcut EAR method cannot be used, and a more detailed mathematical treatment is needed. The method used in this case is often termed "the full probability approach" where the full distributions of requirement and intake are used to estimate the probability that individuals with a particular intake would not meet their requirement. (FNB (1986)). This approach has been used historically to assess iron (Anderson *et. al* (1982)).

The analysis presented here uses the full probability approach but has expanded the methodology to allow a number of uncertainty factors to be included in the estimation: specifically, uncertainty around the fraction of oral contraceptive (OC) users and uncertainty around the distribution of iron intakes due to sampling. As noted in the FNB (2001) the distribution of requirements is significantly influenced by OC use and needs to be considered in arriving at an estimated requirements distribution for the population. In these calculations, the proportions of self reported OC users are estimated from the 136 and 300 British Columbia (BC) respondents aged 19-30 and 31-49, respectively, who are healthy and not pregnant. These two samples are extracted from the 1998-1999 National Population Health Survey (NPHS) conducted by Statistics Canada (*For more information about NPHS 1998-1999 see http://www.statcan.ca/english/IPS/Data/82F0068XIE.htm*). Uncertainty in these proportions is characterized by the 95th% confidence interval calculated taking the complex survey design of the NPHS into account, using the specialized variance estimation software SUDAAN. The distribution of usual iron intakes is estimated from usual food and supplement consumptions of 1821 BC respondents aged 19 -84 who responded to the BC Nutrition Survey. Uncertainty around the intake distribution is characterized using the 95th% confidence intervals for percentiles of the distribution accounting for the stratified sample design of the BC Nutrition Survey, again using SUDAAN.

The expanded probability method uses a two dimensional Monte Carlo simulation to propagate the uncertainties through the probability approach and the results are presented in Tables 1 and 2. (A technical document will be available providing more details about the techniques used and comparing this approach with alternatives.)

Table 1
Weighted Fraction of Oral Contraceptive Users * and its 95% Confidence Interval in Adults Aged 19-49

Age group	Sample size	Weighted Mean	95% Lower Limit	95% Upper Limit
Female, 19-30	136	0.261	0.187	0.335
Female, 31-49	300	0.102	0.068	0.136

* The weighted fraction of OC users and its 95% CI are estimated from the 1998-1999 National Population Health Survey (NPHS) data collected by Statistics Canada (*For more information about NPHS 1996-1997 see http://www.statcan.ca/english/IPS/Data/82F0068XIE.htm*).

Table 2
Estimated Percent of BC Population With Iron Intakes Below Requirement Including Uncertainty in OC Fraction and Intake Distribution

Estimated Percent BC Population Below Requirement (lower 95th CL, upper 95th CL)					
F 19-30 (n*=176) (%)	F 31-49 (n*=244) (%)	F 50 and over (n*=534) (%)	M 19-30 (n*=142) (%)	M 31-49 (n*=194) (%)	M 50 and over (n*=531) (%)
11.67 (10.06 -13.73)	15.62 (14.6-17.55)	0.8 (0.54- 1.11)	0.04 (0- 0.24)	0.03 (0.05 - 0.29)	0.97 (0.34 – 1.93)

* n= Sample size

2. Comments

- In November 2002, the BBCA performed an analysis of the probability of inadequate iron intakes in BC from food and supplement sources using the first version of the BCADJFDSUX data. A second version of this data has been released due to errors found in the first version. The analysis presented in this paper is based on the second version of the BCADJFDSUX data, and is intended to replace the previous analysis.

- In the '*techrep E451313- 011CV1, August 2002*' report by Hayward, 27% of the BC population reported consuming some supplemental iron, ranging with age in males from 19% - 24% and in females, 24%-40%. The two youngest female groups aged 19-30 and 31-49 have the percents of some supplemental iron of 28% and 36% respectively.

- Note that the probabilities of inadequate iron intakes in females and males found in the current analysis are slightly higher than those in the previous analysis (done in November 2002).

References

Anderson, G.H. Peterson, R.D. and Beaton, G.H.(1982) "Estimating nutrient deficiencies in a population from dietary records: the use of probability analyses", *Nutr. Res.* **2,** 409-415.

Carriquiry, A.L. (1999) "Assessing the prevalence of nutrient inadequacy", *Pub. Health Nutr.* **2**, 23-33

Food and Nutrition Board, NRC (1986) *Nutrient Adequacy: Assessment Using Food Consumption Surveys*, National Academy Press: Washington.

Food and Nutrition Board, Institute of Medicine(2000) *Dietary Reference Intakes: Applications in Dietary Assessment.* National Academy Press: Washington

Food and Nutrition Board, Institute of Medicine(2001) *Dietary Reference Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium and Zinc* National Academy Press: Washington

Appendix O

Influence of Education Level, Low Income and Geographic Strata on the Intakes of Seven Nutrients Determined by Analysis of Variance

Appendix O: Influence of Education Level, Low Income and Geographic Strata on the Intakes of Seven Nutrients Determined by Analysis of Variance

Nutrient	**Education Level**		**Low Income**		**Geographic Strata**	
	F value	**P value**	**F value**	**P value**	**F value**	**P value**
Folate	1.299	.273	.955	.329	.974	.378
Vitamin B6	.373	.689	.066	.798	.794	.452
Vitamin B12	3.614	.027	.274	.601	.257	.759
Vitamin C	5.965	.003	.120	.729	.500	.607
Calcium	1.009	.365	.515	.473	.594	.552
Magnesium	.967	.381	1.552	.213	520	.595
Zinc	.486	.615	1.125	.289	1.538	.215

Appendix P

Analysis of Non-Response

ANALYSIS OF NONRESPONSE

BRITISH COLUMBIA NUTRITION SURVEY 1999

Report BBCA 451311-0010NR

February 2002

L. Nguyen,
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Bureau of Biostatistics and
Computer Applications
Food Directorate
Health Canada

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§ 1. Back ground

The British Columbia Nutrition Survey (NBNS) was conducted as a federal-provincial collaboration in two phases: April-July 1999 (spring) and September-December 1999 (fall). During this time, men and women between the ages of 18 and 84, living in British Columbia (excluding those who were pregnant, lactating, institutionalized or living on reserve lands) were approached through an initial letter and telephone follow-up to participate in a food and nutrition survey. The data were collected during a face-to-face interview. The survey consisted of five instruments: a 24 hour recall, a quantitative food frequency questionnaire, a demographic questionnaire, a provincial special interest questionnaire and information pertaining to the response/non-response status of sampled individuals. Approximately, half of the sample was interviewed during the Spring and the other half in the Fall of 1999. There was a repeat 24-hour recall for a sub-sample of the participants, every third name sampled being identified for a repeat.

A detailed analysis of response/non-response issues was conducted by the Bureau of Biostatistics and Computer Applications (BBCA) in the Food Directorate in Health Canada (HC). This document summarizes these results, discusses the development of survey weights, and examines some of the factors which may indicate potential bias in the nutritional results of the responding population due to the non-response mechanism.

1.1 Sample Design

The sampling plan for both phases, (or seasons), designed by the Special Surveys Methods Division in Statistics Canada, France Bilocq, 1999 (Appendix B1), was a stratified multi-stage sampling design. At the first stage of the sample selection, the population was stratified into three strata: Metro (stratum 1) consisting of 6 geographic regions (or sub-strata); Coastal (stratum 2) containing 1 geographic region (sub-stratum); and Non-metro consisting of 10 geographic regions (clusters). In strata one and two, each geographic region (substratum) was selected with certainty, termed "chosen with probability 1", while in stratum three, 4 geographic regions (or clusters) were randomly chosen with probability proportional to the population size of the regions. The British Columbia Health Register File (BCHR) was used as the frame to select the sample of individuals for each season. All individuals on the BCHRF that fell within the selected areas for each stratum were stratified into 14 age-sex groups: males/females, ages 18-24, 25-34, 35-44, 45-54, 55-64,65-74 and 75-84.

At the second stage, a sample of individuals was selected from the BCHR according to the sample allocation in each stratum-age-sex combination. An estimate of 5320 names was required to drawn in the Spring 1999 and divided equally for two seasons in order to obtain expected responses of 1364 in each season. The dividing process was done as the first, third, fifth name sampled ... etc., being identified for Spring (phase 1) and the second, fourth, sixth name sampled .... etc., being identified for Fall (phase 2). For more detailed information about the sample design, see Sample Design Specifications, France Bilocq, 1999.(Appendix B1)

Approximately one third of the sample was randomly selected for a repeat 24 hour recall. In order to try covering all days equally, both the initial and repeat interview days were randomly assigned a day of the week and the repeat interview was scheduled no sooner than one week after the first interview.

It should be note that while the survey was conducted in 1999, the stratification and sampling of the primary units were done using 1996 census data and the sampling of individuals was done using 1999 BCHR.

Table 1.1 presents a summary of the sampling and resulting respondents with usable interviews by season (phase) and region. Table 1.2 summarizes the results by season and age-sex group. From 5273 people selected (2658 people drawn in spring and 2615 people drawn in the fall), there were 1823 usable first interviews (868 in the spring and 955 in the fall) and 479 usable second interviews (229 in the spring and 250 in the fall).

A summary of the sampling and resulting respondents is provided in Tables 1.1 and 1.2.

Table 1.1

BCNS: Sampling by Geographic Region and Season

	Season																				
	Spring 99							Fall 99							Total						
Geographic region	Number drawn	Number responding	Reliable complete responses	Reliable partial response	Number repeats	Reliable complete repeat	Reliable partial repeat	Number drawn	Number responding	Reliable complete responses	Reliable partial response	Number repeats	Reliable complete repeat	Reliable partial repeat	Number drawn	Number responding	Reliable complete responses	Reliable partial response	Number repeats	Reliable complete repeat	Reliable partial repeat
Vancouver	447	157	151	6	46	46	0	450	165	162	3	41	41	0	897	322	313	9	87	87	0
Victoria	238	67	66	1	12	11	0	231	83	82	1	20	20	0	469	150	148	2	32	31	0
Nanaimo	135	41	41	0	10	10	0	134	54	54	0	11	11	0	269	95	95	0	21	21	0
Kamloops	149	44	44	0	12	12	0	146	64	63	0	15	15	0	295	108	107	0	27	27	0
Kelowna	165	53	53	0	11	11	0	162	60	59	1	13	13	0	327	113	112	1	24	24	0
Prince George	151	46	45	1	14	14	0	152	37	37	0	9	9	0	303	83	82	1	23	23	0
Coastal	618	186	184	1	51	51	0	603	237	235	2	76	76	0	1221	423	419	3	127	127	0
Kootenay	187	73	72	1	19	19	0	185	47	45	2	14	14	0	372	120	117	3	33	33	0
Chilliwack	188	53	52	1	11	10	1	183	69	68	1	17	17	0	371	122	120	2	28	27	1
Vernon	192	86	86	0	26	26	0	188	86	83	2	20	20	0	380	172	169	2	46	46	0
Terrace	188	63	63	0	18	18	0	181	55	53	2	14	14	0	369	118	116	2	32	32	0
Total	2658	869	857	11	230	228	1	2615	957	941	14	250	250	0	5273	1826	1798	25	480	478	1

Table 1.2
BCNS: Sampling by Age-Sex Group and Season

	season														Total						
	Spring 99							Fall 99													
	Number drawn	Number responding	Reliable complete responses	Reliable partial response	Number repeats	Reliable complete repeat	Reliable partial repeat	Number drawn	Number responding	Reliable complete responses	Reliable partial response	Number repeats	Reliable complete repeat	Reliable partial repeat	Number drawn	Number responding	Reliable complete responses	Reliable partial response	Number repeats	Reliable complete repeat	Reliable partial repeat
age-sex group																					
M 18-24	177	44	44	0	12	12	0	175	41	41	0	12	12	0	352	85	85	0	24	24	0
M 25-34	227	48	48	0	9	9	0	202	54	51	3	11	11	0	429	102	99	3	20	20	0
M 35-44	177	45	44	1	9	9	0	177	60	59	1	17	17	0	354	105	103	2	26	26	0
M 45-54	146	43	42	0	12	12	0	147	46	46	0	12	12	0	293	89	88	0	24	24	0
M 55-54	128	44	42	2	12	12	0	145	51	51	0	12	12	0	273	95	93	2	24	24	0
M 65-74	218	95	93	2	29	29	0	211	99	97	2	27	27	0	429	194	190	4	56	56	0
M 75-84	255	98	96	2	30	28	1	250	103	100	1	28	28	0	505	201	196	3	58	56	1
F 18-24	180	41	41	0	10	10	0	178	59	59	0	15	15	0	358	100	100	0	25	25	0
F 25-34	226	65	64	1	19	19	0	216	63	62	1	17	17	0	442	128	126	2	36	36	0
F 35-44	180	62	62	0	13	13	0	169	69	68	1	16	16	0	349	131	130	1	29	29	0
F 45-54	136	64	63	1	15	15	0	148	60	60	0	17	17	0	284	124	123	1	32	32	0
F 55-64	138	63	63	0	15	15	0	123	67	67	0	29	29	0	261	130	130	0	44	44	0
F 65-74	211	71	70	1	20	20	0	219	98	95	3	15	15	0	430	169	165	4	35	35	0
F 75-84	259	86	85	1	25	25	0	255	87	85	2	22	22	0	514	173	170	3	47	47	0
Total	2658	869	857	11	230	228	1	2615	957	941	14	250	250	0	5273	1826	1798	25	480	478	1

1.2 Nonresponse and Bias

The term "bias" is used to describe an effect which systematically distorts a result so that it loses its "representativeness" of the truth. Bias can arise in survey results for a number of reasons such as: a particular estimator chosen; errors in the respondent's answers (perhaps due to concealment of the truth, poorly designed questions, or ability of the respondent to answer); errors in the sampling operations; non-interviews or nonresponse. In this document, the concern is focussed on the last of these, and the potential biassing, or distorting effect that non-response in the BCNS may have on the survey results. The Tables 1.1 and 1.2 above suggest that there are geographical areas and age-sex groups where the biassing effects of non-response may need to be kept in mind. (In section 3, various rates to quantify the non-response are discussed.)

The mean of a variable is a good estimator to help understand the numerical aspect of bias. Suppose that:

$\overline{Y}$ = mean of a variable for the entire sample, and unbiased for population value μ;

$\overline{Y}_R$ = expected value of the mean of a variable for the respondents only; and

$\overline{Y}_{NR}$ = expected value of the mean of a variable for the non- respondents only.

Then bias due to the non-response, B, is defined as

$$B = \overline{Y}_R - \overline{Y} \qquad (1)$$

If we define P_{NR} as the probability of nonresponse and P_R as the probability of response, then we can rewrite $\overline{Y}$ as

$$\overline{Y} = \overline{Y}_R P_R + \overline{Y}_{NR} P_{NR} \qquad (2)$$

Combining (1) and (2), we find that the bias can be re-written as:

$$B = (\overline{Y}_R - \overline{Y}_{NR}) P_{NR} \qquad (3)$$

From (3) we see that the bias will be large if there is a large difference between respondents and nonrespondents for the variable of interest, or if the probability of non-response is high. Hence, we need to evaluate two features of the survey outcome: the probability of non-response and the similarity of the responding/nonresponding population on the nutritional variables of interest.

Bias affects more than just the estimators from the survey: it also plays a role in the magnitude of the variances of the estimators. Consider an estimator $\overline{y}$ of a population value μ, formed from the respondents only. Let us say that it is biassed with an expected value of $\overline{Y}_R$ and a bias B.

Then $\bar{y}$ will be distributed about its own expected value with a variance $V(\bar{y})$ and standard deviation $SD(\bar{y})$. When we make statements about the accuracy of the estimate, it is this variance that is used in the calculations such as those declaring with a given probability, that the estimate is in error by more than 2 standard deviations. However, what is actually needed for these probability calculations is the variance of $\bar{y}$ about the true population value μ. This variance is termed Mean Square Error (MSE) and it can be shown that

$$MSE(\bar{y}) = V(\bar{y}) + B^2 \qquad (4)$$

The magnitude of $V(\bar{y})$ can be minimized by increasing the number of sampled units. However, if the response mechanism is the same for all respondents, then the bias is not reduced with further sampling. The amount of the disturbance by the bias to the distribution of $\bar{y}$ depends on the ratio of the bias to the standard deviation of $\bar{y}$, i.e. $B/SD(\bar{y})$. The ultimate effect of this unknown bias in the survey is to give rise to tests of hypotheses with incorrect probabilities.

In light of the substantial effect that bias from non-response can have on the estimates and tests of hypotheses, it is important to try and assess both the magnitude and the type of bias which may be in the BCNS.

§ 2. Non-response Methodology

Calculation of the response rates for the BCNS are based on the Statistics Canada Methods and Standards Committee document "Standards and Guidelines for Reporting of Non-response Rates: Definitions, Framework and Detailed Guidelines (1992)" These guidelines have been used to categorize the results from the initial contact and the interview step to estimate the magnitude and pattern of response.

2.1 Response Categories.

All of the narrative comments and non-response codes noted by the interviewers during the telephone recruitment were reviewed by BBCA and grouped into categories in a non-response accounting framework. A response category was assigned to each telephone recruitment outcome:

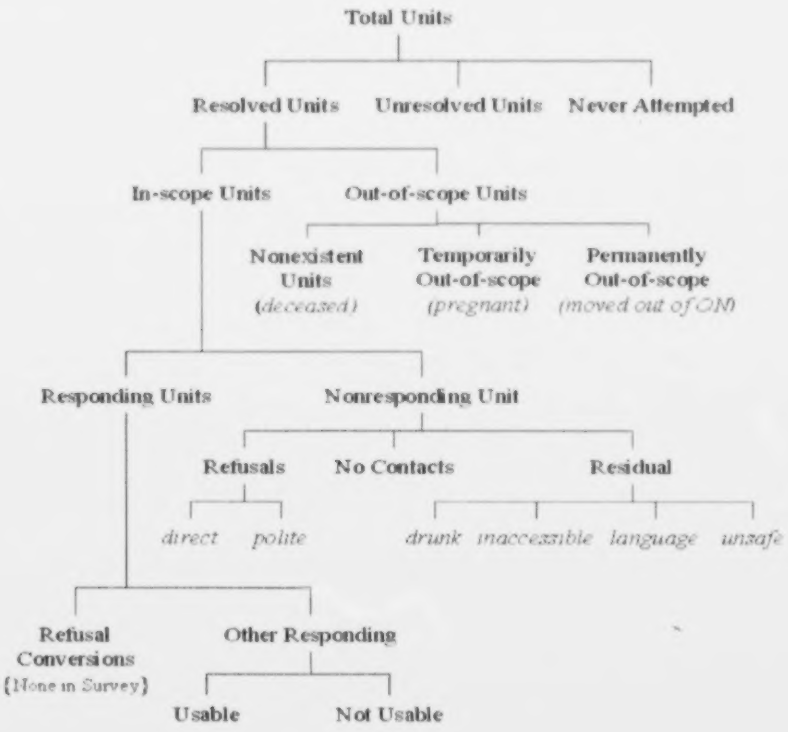
Responder →	granted an interview ;
Nonresponding →	in scope individuals who refused, were not available, or through some other circumstances were not able to complete an interview;
Not in scope →	individual not meeting the sampling criteria (pregnant for example); and
Not resolved →	never able to determine if in scope after six attempts at contact.

More details about these classes are provided in the Appendix A with examples of the types of responses which fit into each.

Figure 2.1 below is an adaptation of a similar figure given in the Statistics Canada Standards cited above, showing the different outcomes at data collection. (Examples of the type of responses are noted in italics on the figure.)

Figure 2.1

Respondent/Nonrespondent Categories[1]


Total Units
Resolved Units
Unresolved Units
Never Attempted
In-scope Units
Out-of-scope Units
Nonexistent Units
(deceased)
Temporarily Out-of-scope
(pregnant)
Permanently Out-of-scope
(moved out of ON)
Responding Units
Nonresponding Unit
Refusals
No Contacts
Residual
direct
polite
drunk
inaccessible
language
unsafe
Refusal Conversions
{None in Survey}
Other Responding
Usable
Not Usable

[1] Chart adapted from Statistics Canada Methods and Standards Committee (1992) "Standards and Guidelines for Reporting of Non-response Rates: Definitions, Framework and Detailed Guidelines".

2.2 Response Summary - Accountability Table

The term "accountability tables" is often used in the literature to describe the summary tables accounting for the response/non-response status of each individual drawn for the sample (see page 29, "Incomplete Data in Sample Surveys" (1983) Vol. 1 Chapter 3, ed. W. Madow, H. Nisselson, I. Olkin). Table 2.1 provides a general accountability table for the BCNS.

Table 2.1
Response Status for the BCNS by Season

Summary Status	Spring 1999	Fall 1999	Total
Drawn	2658	2615	5273
Attempted	2397	2502	4899
Resolved	1965	2044	4009
Eligible	1716	1772	3488
Responding with interview	869	957	1826
Response Usable 1st Recall (% of eligible cases)	868 (51%)	955 (54%)	1823 (52%)
Repeat Recalls (% of usable 1st Recalls)	229 (26%)	250 (26%)	479 (26%)

Accountability tables by age, sex and geographic region are provided in Appendix A3 (Tables A3.1 and A3.2). The detailed tables indicate that while the overall rate for repeat recalls is somewhat close to the 1/3 targeted, particular age-sex groups and regions give rise to concern.

§ 3. Calculation of Rates

3.1 Methodology

Calculation of "rates" for a survey such as the BCNS can be carried out in a number of ways and there are many examples in the literature. The methodology below follows the approach given in the Statistics Canada documentation "Standards and Guidelines for Reporting of Non-response Rates: Definitions, Framework and Detailed Guidelines (1992)".

3.1.1 Data Collection Rates vs. Analysis Rates

Two types of rates need to be considered: those related to the data collection process and those related to the analysis phase. The primary difference between the two types of rates lies in the classification of (1) the unresolved cases, and (2) the unusable interviews. The latter are considered successful responses at the data collection phase, however, at the analysis stage, they are considered as nonrespondents and are handled in a straightforward manner. The unresolved cases are more problematic. At data collection, the unresolved cases are clearly nonrespondents, and are considered as part of the total potential response group. At the analysis stage, this group needs to be examined more closely, looking at the reason these cases were left unresolved. If the unresolved are not responding because they have moved out the province or are dead, then they are out of the scope of the study, and do not add to the bias in the analysis. However, if they are unresolved because they represent a pocket of hard-to-reach individuals, then they are in scope and should be considered as potential responders. As such, these unresolved cases may contribute to bias in the analysis.

In the absence of information needed to estimate how many unresolved cases are actually in scope, one approach is to place upper and lower bounds on the analysis rates. The most optimistic assumption is that all unresolved cases are counted as out-of-scope individuals, i.e. zero in scope. Rates calculated under this assumption represent upper bounds. Alternatively, lower bounds are calculated under the assumption that all unresolved cases represent for in-scope individuals. The true rates likely lie between these values, rather than at the extremes.

3.1.2 Calculation of Rates

In the BC Nutrition Survey, there are four rates of interest: resolved/located, in-scope, refusal and response rate. Of these, only response rate needs to address the unresolved and unusable interview issue described above. Rate calculations are as follows:

1. Resolved Rate = $\frac{\text{Number Resolved}}{\text{Total Attempted}}$

2. In-scope Rate = $\frac{\text{Number In-scope}}{\text{Number Resolved}}$

3. Refusal Rate = $\frac{\text{Number of Refusals}}{\text{Number In-scope}}$

4. Response Rate

Data Collection:

$$\frac{\text{Number Responding}}{\text{Number In-scope + Unresolved}}$$

Analysis Stage:

$$\frac{\text{Number responding - Unusable}}{\text{Number In-scope + Estimated In-scope}}$$

where *estimated in-scope* represents the number of unresolved predicted to be in-scope. As discussed previously, in the absence of more information, the upper and lower bounds can be used.

3.2 Results

Detailed tables of the above rates are given in Appendix A4 by geographic region, age-sex group and season. Note that in the tables in Appendix A4, the value of "N" reflects the number in the denominator for the formulas above.

The text below provides some observations about the patterns of the different rates. Summary rates have been graphed below to illustrate the findings.

Resolved Rate (*graph 3.1, Appendix A4.1.1, A4.1.2*) Overall 82% of the names drawn were located and approached to participate in the survey. This rate varied across geographic areas with Prince George being lowest (73%) and Vernon being highest (89%). The Metro and Coastal regions had lower resolved rates than the Non-Metro regions with the exception of Kelowna (88%). The resolved rate of this region is as high as the Non-Metro regions. Generally, resolved rates were higher in males than females, but the pattern over age groups was consistent in both gender groups: the rate was lowest in the younger group and generally increased by age (With the exception of male age group 65 - 74: the resolved rate (88%) in this age group is slightly lower than in the male age group 55 - 64 (90%).) This pattern is expected as younger individuals are more likely to be more mobile than older ones.

In Scope Rate: *(graph 3.2, Appendix A4.2.1, A4.2.2)* Overall, 87% of the resolved names were in scope. The rate wasquite similar between the Metro and Coaster regions but slightly higher than the Non-metro regions (Kelowna highest (91%) and Chilliwack lowest (79%)). The pattern of in scope rates was consistent in both gender groups: the rate appeared to be lowest in the youngest age group (18-24) increasing with age and dropping off in the older age groups. This pattern is expected as pregnancy and transient residence affect the in scope status of the youngest ages, while factors such as severe illness, seasonal residences are prominent in the older groups.

Refusal Rate: *(graph 3.3, Appendix A4.3.1, A4.3.2)* Overall, 38% of the in-scope names refused to participate in the study. This rate varied amongst the geographic areas with Vancouver being the lowest (32%) and Chilliwack having the highest (46%). The pattern of refusal rates was quite consistent over the age groups for both genders up to about 64 years of age at which point, the refusal rate increased by age for males and decreased by age for females.

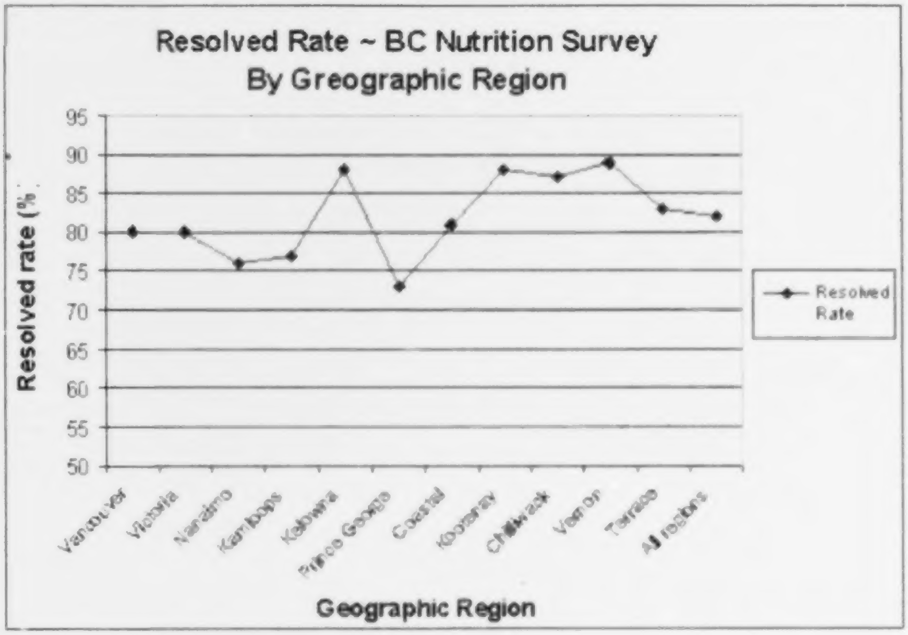
Response Rate: *(graph 3.4, Appendix A4.4.1, A4.4.2)* Overall, the lower and upper bounds of the response rate were 42% and 52% which are computed as:

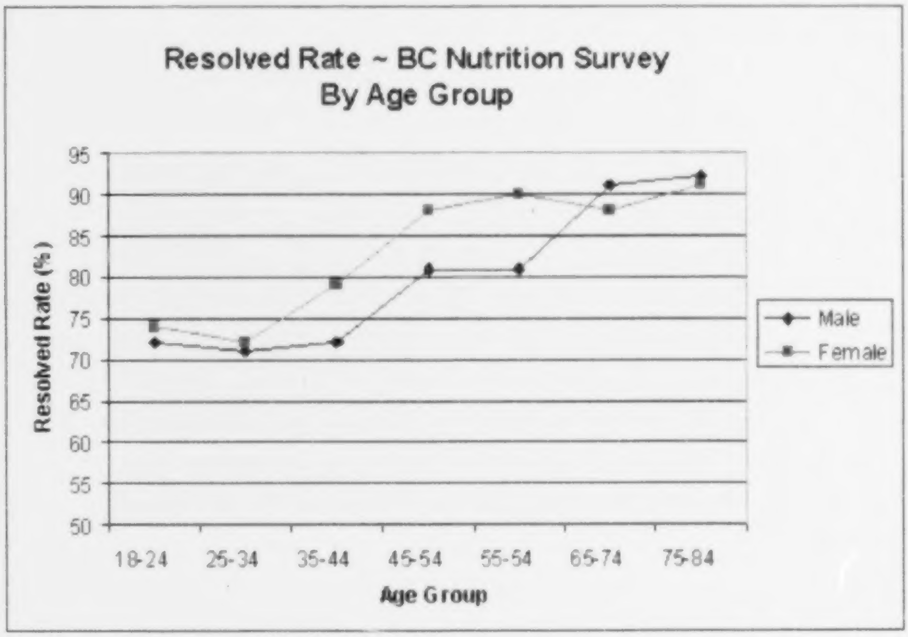
$$\text{The analysis stage of the lower response rate} = \frac{\text{Number of responding - Unusable}}{\text{Number of in scope + Number of unresolved}}$$

$$\text{The analysis stage of the higher response rate} = \frac{\text{Number of responding - Unusable}}{\text{Number of in scope}}$$

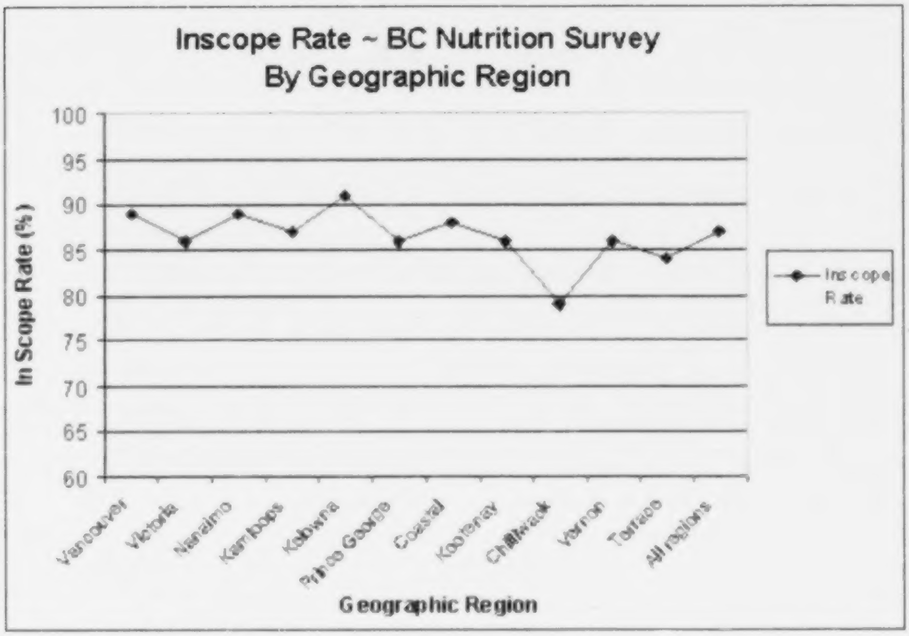
The response rates varied across geographic regions ranging from 31% to 52% for the lower bound and from 45% to 59% for the upper bound. Prince George had the lowest rate whle the highest rate was observed at Vernon. Among the geographic strata, the Metro and Coastal regions have a quite similar response rate (with the exception of Prince George). Response rates were higher for females than males up to 64 years of age at which point males have a slightly higher response rate. Generally, the rate increased with age then decreased in older inviduals: for females decreasing noticably after 64 years for females, but only slightly decreasing after 74 years for males.

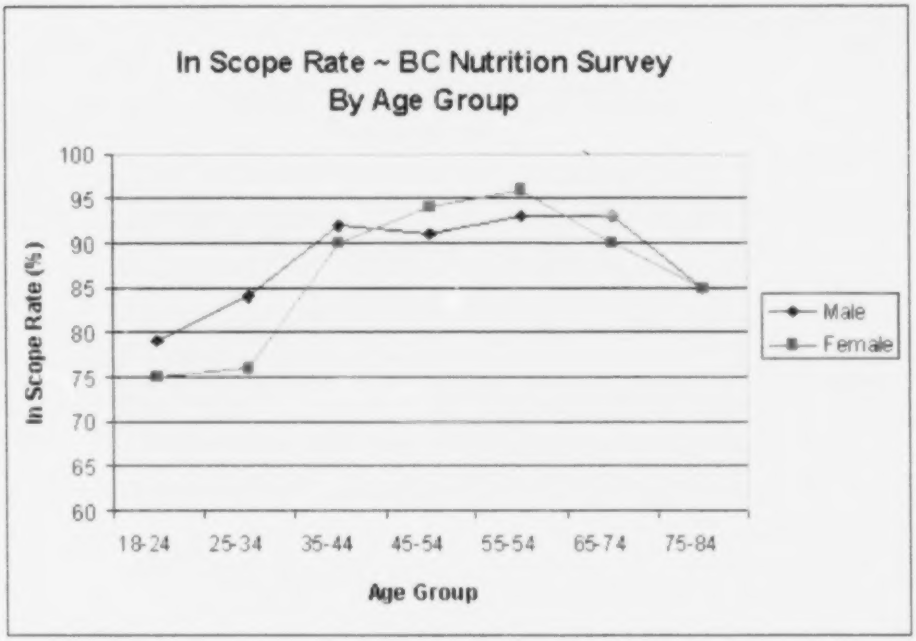
Graph 3.1 Resolved Rates



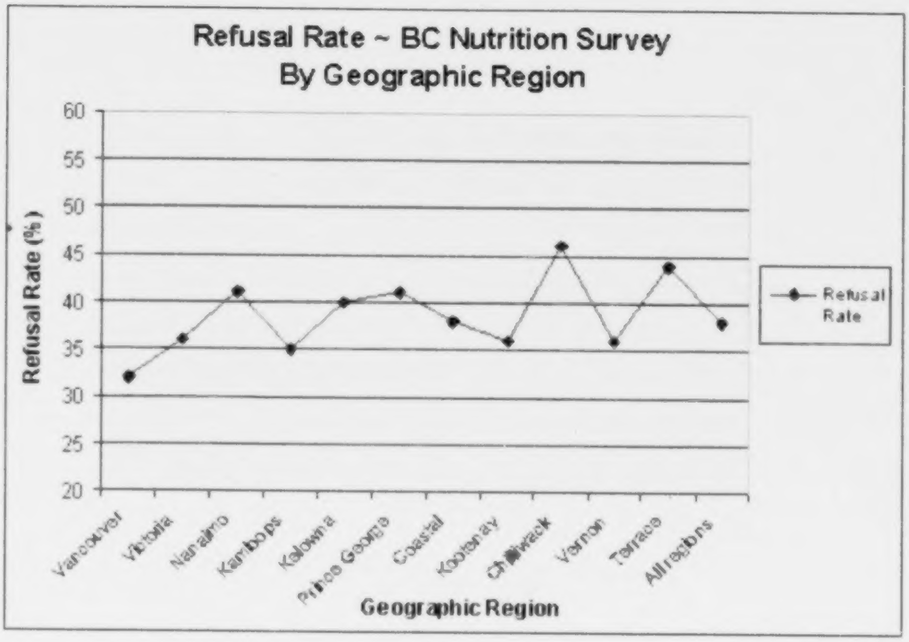


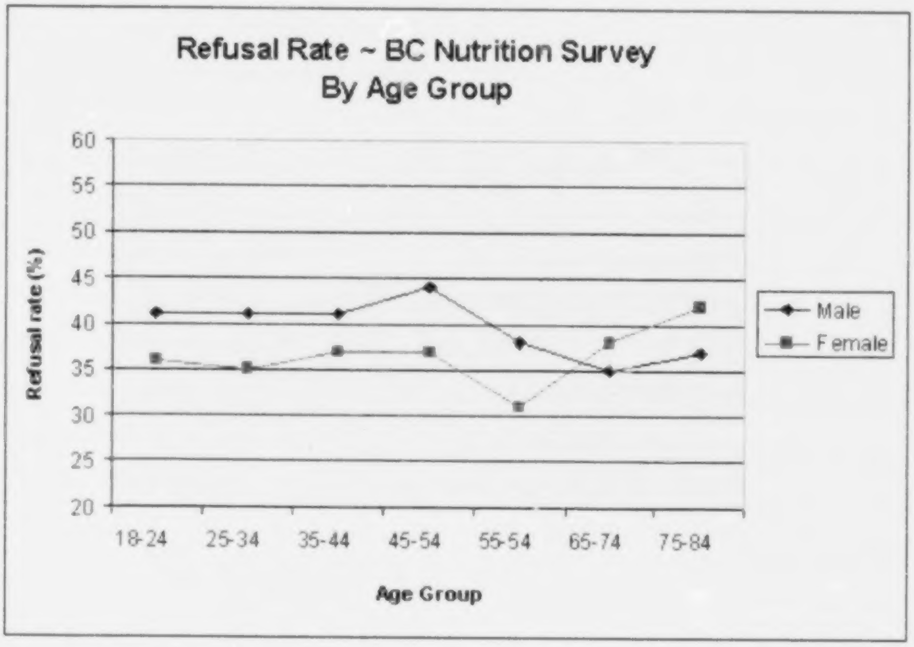
Graph 3.2 In Scope Rates



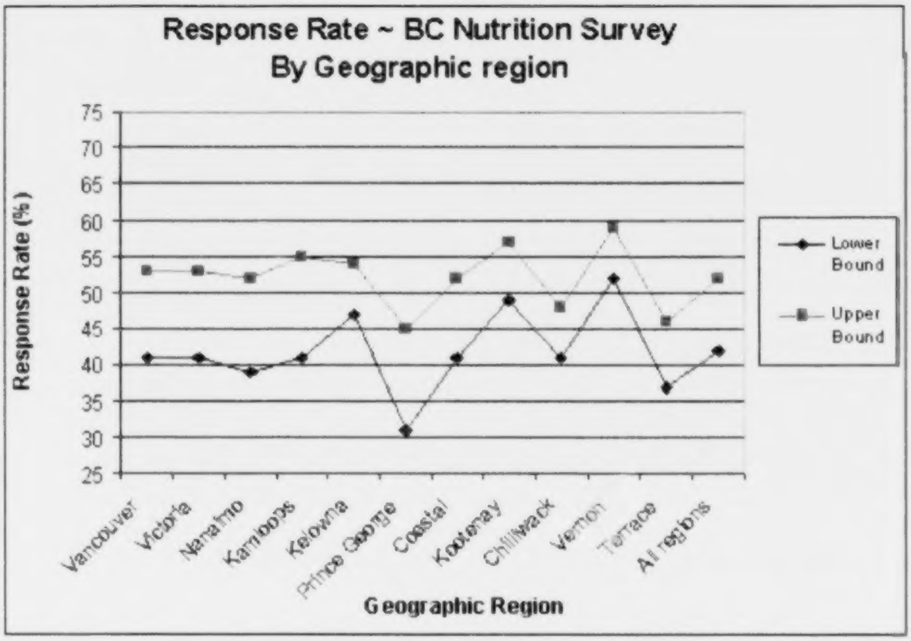


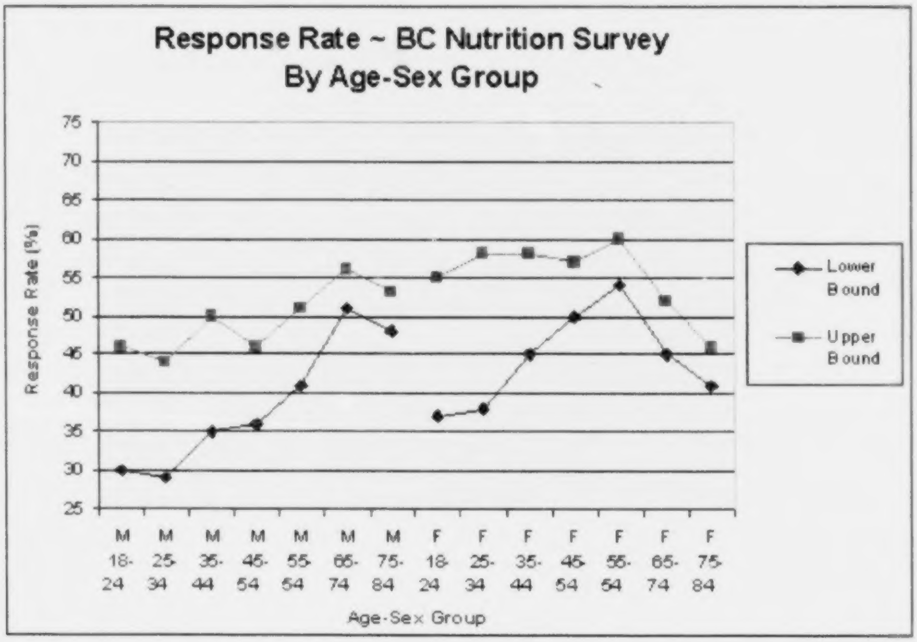
Graph 3.3 Refusal Rates

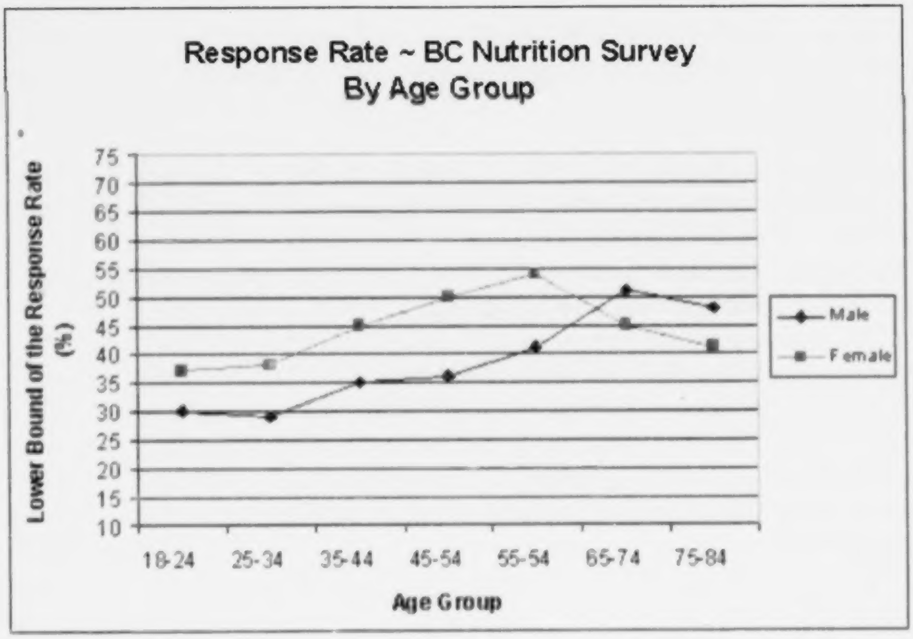


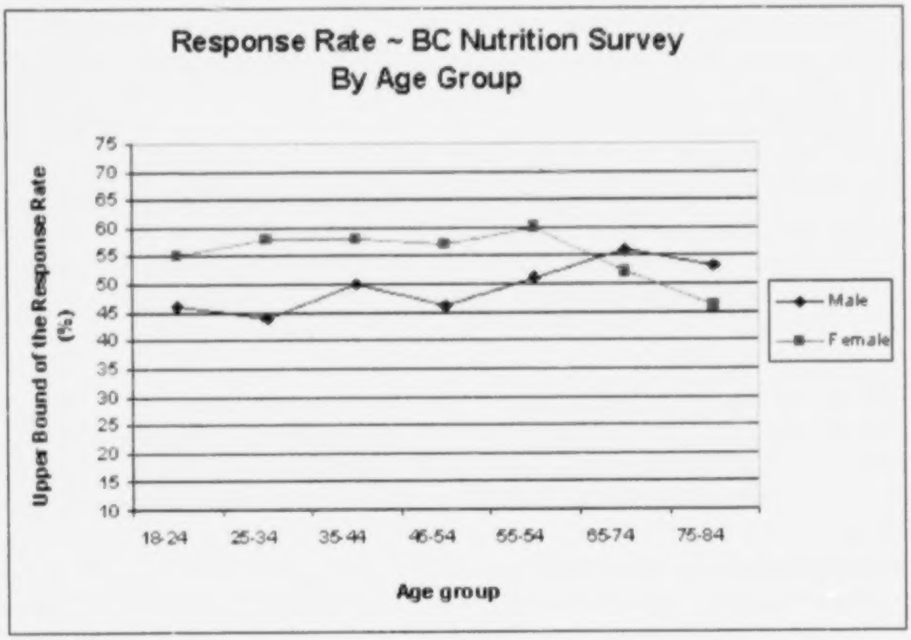


Graph 3.4 Response Rates


Response Rate ~ BC Nutrition Survey
By Geographic region
Response Rate (%)
75
70
65
60
55
50
45
40
35
30
25
Vancouver
Victoria
Nanaimo
Kamloops
Kelowna
Prince George
Coastal
Kootenay
Chilliwack
Vernon
Terrace
All regions
Geographic Region
Lower Bound
Upper Bound


Response Rate ~ BC Nutrition Survey
By Age-Sex Group
Response Rate (%)
75
70
65
60
55
50
45
40
35
30
25
M 18-24
M 25-34
M 35-44
M 45-54
M 55-64
M 65-74
M 75-84
F 18-24
F 25-34
F 35-44
F 45-54
F 55-64
F 65-74
F 75-84
Age-Sex Group
Lower Bound
Upper Bound


Response Rate ~ BC Nutrition Survey
By Age Group
Lower Bound of the Response Rate (%)
75
70
65
60
55
50
45
40
35
30
25
20
15
10
18-24
25-34
35-44
45-54
55-54
65-74
75-84
Age Group
Male
Female


Response Rate ~ BC Nutrition Survey
By Age Group
Upper Bound of the Response Rate (%)
75
70
65
60
55
50
45
40
35
30
25
20
15
10
18-24
25-34
35-44
45-54
55-54
65-74
75-84
Age group
Male
Female

3.3 Discussion

In spring 1999, phase one of data collection, 2658 names were drawn, contact was attempted for 2397 names, from which there were 868 usable interviews. 2615 names were drawn in fall 1999, of which 2502 were attempted and there were 955 usable interviews. In total there were 376 names drawn for which no contact was ever attempted or removed from the sampling frame because the data collection phases were ended before all of the names could be contacted or financial constraints limited activites. These "not attempted" or " removed" were spread fairly equally between seasons (261 & 113) as well as over age, sex and geographic regions. As a result, the not attempted and removed people do not appear to be selective or represent a particular pocket of individuals. Hence, it is not expected that they would add to the bias. The net result is a smaller number of respondents than would have been expected had all of the names been contacted: the smaller number will affect precision of the estimates but should not affect bias.

The overall response rate lies between 42% and 52%. Of particular concern are the lowest rates observed for the male group from 18-24 years, the female group from 75-84 years and the Prince George region. For the young males, the low rate reflects both low resolved rates and high refusal rates: for the older females, it is largely a function of the higher refusal rate. Tests suggest that the rates are to be differential over geographic regions and age-sex groups and hence the bias may present in the same pattern.

The small numbers of respondents in some of the geographic stratum-sex-age-season groups may result in some large sampling weights. Hence, some care will need to be taken when the weights are calculated, using weighting classes of groups with homogeneous response mechanisms. However, it is unlikely that any weighting scheme would be able to "adjust" and rectify the data for the magnitude of potential bias which is present due to the high non-response rate. Also, the paucity of responses in some areas will limit the level to which meaningful breakdowns can be made for results.

§4. Analysis of Factors Affecting Non-response

As mentioned above, to avoid pockets of large sampling weights, some pooling of groups with homogeneous response mechanisms may need to be developed. One step in this process is to examine in more detail the factors affecting the response outcome, identifying groups which may be suitable for pooling for the purpose of calculating weights.

4.1 Logistic Model

To examine the factors affecting response/Non-response outcome, a logistic regression is used to model the log of the relative odds of responding. For any season-region-age-sex cell {hij} in the survey, there is a probability, θ_{hij}, of responding. The logistic regression model relates the probability of responding to t explanatory variables through the relation:

$$\log\left[\frac{\theta_{hij}}{1-\theta_{hij}}\right] = \alpha + \sum_{k=1}^{t} \beta_k \, x_{hijk} \ldots\ldots(5)$$

where α is the intercept parameter, $\{\beta_k\}$ are the t regression parameters representing the main effects and interactions, and $\{x_{hijk}\}$ are the t explanatory variables for the hij^{th} cell.

The parameters for logistic regression models are most commonly estimated by the method of maximum likelihood. These can be obtained by iterative numerical procedures such as iteratively weighted least squares. Inference and hypothesis testing regarding the significance of various factors are usually based on the approximate normality of the parameter estimates. Goodness of fit (or lack of fit) of the model is determined using the analysis of deviance technique, which uses the log-likelihood ratio statistics to examine the significance of the difference between models in a hierarchical scheme. (For details on logistic models, see standard texts such as; Hosmer and Lemeshow, 1989; Everitt, 1977; and Cox, 1970.)

In the discussion below, the term "significant interaction" is used when discussing the results of the logistic regression. When examining two factors, such as age and sex, it may be that the effect of age on the result was different in males, than in females. For example, it may be that with increasing age in males there is an effect in one direction but in females, the effect is in the opposite direction. As a result, the effect of one factor is not consistent over the levels of the other factors, so that the results need to be considered within the combination of the factors to correctly understand the effects on the results.

A logistic model also allows testing the estimated coefficients, and linear combinations of these coefficients to identify those groups with significantly different models of predicted probability of response. Identifying these patterns will be important when forming weighting classes, and pooling the cells to form sample weights.

4.2. Results

Probability of Resolved:

In a model containing geographic stratum, age group, sex, season and their interactions, significant interactions were observed between sex and age group as is expected from Fig 3.1 where we see the resolved rate graphs crossing. In the reduced model without significant lack of fit, the geographic region was a significant main effect. Looking at particular results, the probability of being resolved was significantly different between the Metro and Non-Metro, and between Coastal and Non-Metro strata. Within each season, geographic strata and gender, no consistent pattern of significant differences in probability of being resolved was observed between adjacent age group although significant differences ($p<0.05$) were observed for females in isolated cases.

Probability of Refusal:

In a model containing geographic strata, age group, sex, season and their interactions, significant interactions were observed between geographic stratum and age group, and between geographic stratum and gender. In other words, the effects of the age group and gender on the probability of being refused were different in the various the geographic strata. Season was a significant main effect in the reduced model without significant lack of fit. Overall, probability of refusing was significantly different between Metro and Non-metro strata and between seasons. Within each season, geographic stratum and gender group, no consistent patterns of significant differences between adjacent age groups were observed with isolated exceptions in malesn of the male age groups 18-24 and 25-34.

Probability of Response:

In a model containing geographic strata, age group, sex, season and their interactions, a significant interaction was observed between geographic strata and age group and between gender and age group. In other words, the probability of response within each age group varied differently by geographic strata and gender. In the reduced model without significant lack, season and sex were significant main effects. Within each season, geographic stratum and gender group, no consistent pattern of significant contrasts ($p<0.05$) was observed between adjacent age groups even though they were found in some geographic stratum-season-gender groups.

4.3 Discussion

Given the overall low response rate in the BCNS, several geographic stratum-season-age-sex groups have few, if any, individuals. Thus, some pooling may be necessary in order to stabilize the sampling weights. As discussed above, it was determined that several factors influenced the response outcome (indicated through the response rates, refusal rates and resolved rates). These factors included geographic region, age-groups, season, sex and interactions between these factors.

The probability of refusing and responding were significantly different between seasons. The probability of refusing or being resolved varied significantly between geographic regions. Furthermore, the probability of refusing or responding within geographic regions varied by age and gender. The probability of being resolved or responding were varied significantly different between genders. These results indicate that season, geographic strata and sex have fairly heterogenous response mechanisms which, if combined, may contribute to bias.

Within each geographic strata-sex-season group probability of being resolved, refusing or responding there were some significant differences between several adjacent age groups but no consistent patterns of those differences were found across the geographic-sex-season group. Some repeated exceptions to this occured for refusal and response rates in adjacent male age groups 18-24 and 25-34: this suggests that there may be some underlying heterogeneity of response mechansim which may contribute to bias. This is balanced by the small likelihood that consistent bias is being added to the analysis over the whole study, and (2) by the by the gain in stability of the sample weights through pooling.

5. Analysis of Extra Questions

5.1 Background

As discussed in section 1, bias from non-response is substantial when (1) the probability of non-response is high or (2) if there is a large difference between respondents and nonrespondents with respect to a particular variable of interest. With respect to the first component, the overall response rate for BCNS was estimated lying between 42% to 52%. The next step of the analysis is to examine the second component: how respondents and nonrespondents differ in terms of characteristics related to nutrition. If the respondents and nonrespondents are very similar with respect to their nutritional variables, then the impact of the non-response will be very small. In an attempt to quantify potential differences between the two groups, a few short "extra questions" related to smoking and bread, milk and supplement consumption, education, marital status were asked of respondents and those who refused to participate in the BCNS. Their responses to these extra questions were compared and are discussed below.

5.2 Results

Of the 1373 people who were categorized as refusing to participate in the BC Nutrition Survey, 878 (approximately 66%) answered the 'non-response' question. In the tables below, the number of indiviudals providing answers can appear confusing. There were a number of question specific refusals so that for each of the extra questions, the number of individuals in the estimates will appear to range: in the refuser group the number of responses to the extra questions ranges from 861 to 876; in the responding group, between 15 and 17 individuals did not provide answers to these questions so the number of responses in this group ranges between 1806 - 1808.

5.2.1 Cigarette Smoking

Three specific questions pertaining to cigarette smoking habits were asked of the non-respondents in sequence. The questioning was streamlined in that it stopped at the first 'No' or 'Refusal'. The questions are asked as follows:

> Have you ever smoked 100 or more cigarettes in your life?
> Do usually smoke cigarettes every day?
> How many cigarettes do you smoke a day?

The same questions were asked of respondents in the Demographic Questionnaire. Refusers' responses are compared to those for respondents in Tables 5.1 and 5.2.

Multiple logistic regression models were used to determine whether daily smoking significantly affected the probability of responding taking into account age and sex. Models without significant lack of fit were obtained using the backward elimination of predictors method. No significant interaction terms between daily smokers and age or sex were found, but a significant main effect of daily smokers was observed in the reduced models. In other words, over all probability of response status was significantly different between daily smoker and non-daily smokers and the pattern of this effect did not vary over age-sex groups. Overall 18% of responders and 23% of refusers reported smoking daily. (refer table 5.1).

Among daily smokers, the amount of cigarettes smoked per day by responders and refusers was compared using a standard "t-test". Normal plots for the number of cigarettes smoked per day in both of the responding and the refusing populations indicated that the distributions of these populations were roughly normal. The average number cigarettes smoked per day among responders and refusers were 15.4 and 15.9 cigarettes, respectively which was not significantly different.

These results suggest that over all, the two populations (responders and refusers answering the extra questions) appeared to differ in regard to current daily smoking prevalence however, among daily smokers, the number of cigarettes smoked per day did not differ between the two populations.

Table 5.1
Proportion of Daily Smokers
Responders vs. Refusers

	RESPONSE CATEGORY			
	Responder		Refuser	
	DAILY SMOKERS		DAILY SMOKERS	
	Percent	N	Percent	N
ALL	16.7	1806	23.4	863
SEX				
Male	16.7	860	24.8	427
Female	16.7	946	22.0	436
AGE SEX GROUP				
M 18-24 yrs	20.0	85	25.5	47
M 25-34 yrs	29.7	101	25.4	59
M 35-44 yrs	21.2	104	26.7	60
M 45-54 yrs	17.0	88	33.9	59
M 55-64 yrs	19.1	94	28.9	45
M 65-74 yrs	14.1	192	22.1	77
M 75-84 yrs	7.7	196	16.3	80
F 18-24 yrs	21.0	100	22.5	40
F 25-34 yrs	25.4	126	32.6	46
F 35-44 yrs	25.2	131	27.7	47
F 45-54 yrs	16.3	123	27.8	54
F 55-64 yrs	17.1	129	25.5	47
F 65-74 yrs	12.7	166	21.3	94
F 75-84 yrs	5.3	171	11.1	108

Note: 'N' is total number of individuals providing response to the smoking question.

Table 5.2

Average Number of Cigarette Smoked Per Day Among Daily Smokers
Responders vs. Refusers

Those Who Smoke Daily	Mean	Standard Error of Mean
Responders	15.4	0.52
Refusers	15.9	0.63

5.2.2 Bread Consumption

For bread consumption, both refusers and responders were asked as the following questions:

(1) During the past month did you eat bread?
(2) If yes, what type of bread did you usually eat?
(Note, only one type of bread could be selected per person.)

Responders and refusers answering these two questions were directly compared and the results are listed in table 5.3. More details by age and sex groups is found in Appendix Table A 5.1

Multiple logistic regression was used to model response status (responder or refuser) as a function of bread consumption and bread type while taking into account age and sex. Final models without significant lack of fit were obtained using backward elimination of predictors method.

In the BCNS, almost all of the responders and refusers (who answered the extra questions) reported consuming bread, 98.9 % of responders and 98.5 % of refusers. No significant difference was observed in the proportion of responders and refusers who reported consuming bread (overall or within age and sex groups).

To test bread type, pumpernickel and other breads were grouped together, and those not knowing their bread type (1 responder and 8 refusers) were not included in the analysis. No significant differences in the proportion of responders and refusers who reported consuming a specific bread type were observed. In separate analysis comparing white bread versus non white bread consumption, again there were no significant differences in the proportion of responders and refusers.

These results suggest that the two populations (once again, responders and refusers who answered the extra questions) did not differ in regards to their bread consumption or their reported bread preference.

Table 5.3

Bread Consumption for Responders and Refusers

	Proportion Bread Consumers by Bread Type	
	Responders (1790 Bread Consumers)	**Refusers (861 Bread Consumers)**
Whole Wheat	49.7	51.0
Multi grain	23.7	24.4
White bread	17.5	13.7
Rye, pumpernickel	4.8	4.6
Other	4.1	5.2
Don't know	0.1	0.8

Note: 1809 responders and 874 refusers provided answers to the bread and bread type questions.

5.2.3 Milk Consumption

Two extra questions asked of refusers pertained to their milk consumption. The questions were as follows:

(1) During the past month, did you use milk?
(2) If yes, what type of milk did you usually use?
(Note: only one type of milk could be selected per person.)

The same information was collected from responders in the Demographic Questionnaire. Responders and refusers answering these two questions were directly compared and their responses are outlined in table 5.4.

Multiple logistic regression was used to model response status (responder vs. refuser) as a function of milk consumption and type of milk consumed (whole, 2%, 1%, skim, condensed or other types of milk) accounting for age and sex.. Final models without significant lack of fit were obtained using backward elimination of predictors method.

Consider the results for the proportion drinking milk. Overall, 94.6% of responders and 89.4% of refusers reported drinking milk. (See Table 5.4) From the logistic regression, the probability of responding was significantly effected by milk drinking status, but this effect varied both over sex and over age group. In separate analyses by sex responders reported being milk drinkers significantly more often than refusers, however the difference was greater for females (96% responders, 90% refusers) than for males (93% responders, 89% refusers). Looking at the age groups, the responders reported milk consumption more often than the refusers for those 45 years and older. (This same pattern was evident for 18-24 year olds but was not statistically significant)

Considering the type of milk consumed, the analysis considered skim milk and powdered skim milk as one group, evaporated and other milk as one group, and did not include those who did not know the type of milk (1 responder, 2 refusers). The probability of responding was significantly affected by type of milk and this was found to be consistent over age and sex groups. Further analysis indicates that this is primarily the result of differences in the reporting of evaporated & other types of milk. A Cochran- Mantel- Haenszel statistic based on table scores indicates slight trend for responders report lower fat milk than refusers. Table 5.5 provides percentages for each milk type overall. (More detailed breakdown of responses in Appendix A5)

Table 5.4
Proportion Milk Consumers

	RESPONSE CATEGORY			
	Responder		Refuser	
		DRK MILK		DRK MILK
	N	Percent	N	Percent
ALL	1809	94.6	876	89.4
SEX				
Male	860	92.7	432	88.9
Female	949	96.3	444	89.9
AGE GROUP				
18-24 yrs	185	94.6	87	89.7
25-34 yrs	227	93.0	109	94.5
35-44 yrs	235	93.2	107	95.3
45-54 yrs	211	95.3	114	87.7
55-64 yrs	224	93.8	93	84.9
65-74 yrs	358	95.8	174	86.8
75-84 yrs	369	95.4	192	88.5

Table 5.5
Type of Milk Consumed

Milk Type	Proportion Milk Consumers by Milk Type	
	Responders (1711 Milk Consumers)	Refusers (783 Milk Consumers)
	Proportion (%)	Proportion (%)
Whole milk	10.5	13.2
2 %	43.0	44.4
1%	24.3	23.8
Skim milk	16.2	14.2
Powdered skim	0.8	1.2
Evaporated milk	1.2	0.6
Other	4.0	2.3
Don't know	<0.1	0.3

5.2.4 Use of Vitamin-Mineral Supplements

Refusers who agreed to complete this question were asked the following:

"During the past month, did you take any vitamin-mineral supplements?"

The same information was collected from responders in the Demographic Questionnaire. Responders and refusers answering this extra question were directly compared using multiple logistic regression which modelled response status (responder vs. refuser) as a function of supplement use taking into account age and sex. Their responses to these questions are outlined in Table 5.6.

Overall, 66% of responders and 60% of refusers reported vitamin supplement use. The reduced logistic model without a significant lack of fit indicated that the significant main effect of vitamin-mineral consumption was observed and this effect was consistent over age and sex Responders were more likely to report consuming supplements in the past month than refusers who answered the extra questions.

Table 5.5

Vitamin and Mineral usage Among Responders vs. Refusers

	RESPONSE CATEGORY			
	Responder		Refuser	
		SUPP USE		SUPP USE
	N	Percent	N	Percent
ALL	1809	66.2	874	59.8
SEX				
Male	860	60.2	431	53.1
Female	949	71.7	443	66.4
AGE GROUP				
18-24 yrs	185	55.1	87	49.4
25-34 yrs	227	58.1	109	48.6
35-44 yrs	235	59.6	107	59.8
45-54 yrs	211	64.9	113	47.8
55-64 yrs	224	67.9	94	72.3
65-74 yrs	358	72.3	172	64.5
75-84 yrs	369	74.8	192	67.7

5.2.5 Education

Both refusers and responders were asked to provide the highest level of education. This was categorized by the interviewer into one of 10 categories, ranging from no school to bachelors degree or above. Miss classification of educational attainment can make the comparisons difficult: the comparison of Bachelor's degree or above versus all other categories was used as one of the "cleanest" to study. Table 5.6 below provides the summary results for education.

Overall, 14% of responders and 9% of refusers reported bachelor degree or above. Multiple logistic regression was used to model response status (responder vs. refuser) as a function of education accounting for age and sex. This analysis found that education was a significant factor in the model of the probability of responding. There were no interactions between education and sex or age.

Table 5.6
Bachelor Degree and Above
Responders vs Refusers

	RESPONSE CATEGORY			
	Responder		Refuser	
		BACH+ DEGREE		BACH+ DEGREE
	N	Percent	N	Percent
ALL	1808	14.4	861	9.2
SEX				
Male	860	16.2	423	11.8
Female	948	12.9	438	6.6
AGE GROUP				
18-24 yrs	185	8.1	87	3.4
25-34 yrs	227	19.8	109	22.9
35-44 yrs	235	19.6	105	12.4
45-54 yrs	211	19.4	113	9.7
55-64 yrs	224	11.6	92	7.6
65-74 yrs	358	12.8	169	4.1
75-84 yrs	368	11.4	186	7.0

5.2.6 Marital Status

Both refusers and responders were asked to provide the marital status: married or living common law; divorced; separated; widowed; never married.

Multiple logistic regression was used to model response status (responder vs. refuser) as a function of marital status accounting for age and sex. This analysis found that after accounting for age and sex, there was no significant of marital status in the model. Table 5.7 below provides the summary comparison for marital status between the two groups.

Table 5.6
Marital Status
Responders vs Refusers

	RESPONSE CATEGORY											
	Responder						Refuser					
		SINGLE	MARRIED	WIDOWED	DIVORCED	SEPARATED		SINGLE	MARRIED	WIDOWED	DIVORCED	SEPARATED
	N	Percent	Percent	Percent	Percent	Percent	N	Percent	Percent	Percent	Percent	Percent
ALL	1806	15.1	65.2	10.2	6.4	3.2	861	16.5	64.1	11.7	5.1	2.6
SEX												
Male	858	16.9	70.0	5.6	4.1	3.4	422	19.2	69.2	4.5	4.7	2.4
Female	948	13.5	60.8	14.3	8.4	3.0	439	13.9	59.2	18.7	5.5	2.7
AGE GROUP												
18-24 yrs	185	78.9	19.5	0.0	0.5	1.1	87	75.9	21.8	0.0	0.0	2.3
25-34 yrs	225	32.9	59.6	0.0	2.7	4.9	109	33.9	59.6	0.9	3.7	1.8
35-44 yrs	235	12.3	73.6	0.4	7.7	6.0	104	11.5	78.8	1.0	5.8	2.9
45-54 yrs	209	2.4	82.3	1.4	10.0	3.8	112	11.6	69.6	2.7	9.8	6.3
55-64 yrs	224	3.1	76.3	5.8	12.1	2.7	93	4.3	80.6	6.5	6.5	2.2
65-74 yrs	359	2.2	75.5	13.6	5.6	3.1	169	3.6	74.0	14.2	6.5	1.8
75-84 yrs	369	1.1	59.6	32.0	6.0	1.4	187	2.1	57.8	35.3	3.2	1.6

5.3 Discussion

Of the total refusers in the BCNS, about 66% were willing to answer questions on smoking, bread, milk, and vitamin/mineral consumption, education and marital status. Of the 1320 refusers, 117 (9%) were never approached to answer the A2 because they refused by virtue either of cancelling and not being willing to rebook, or by not showing up to the interview and never agreeing to another time. Of the 1195 refusers asked to complete the A2, 878 (73%) did agree. (Additional analysis found slightly higher rates of this further refusals in males, in the 75-84 year group, and in strata 1.) This is a relatively good response rate however, it is possible that the further refusers are not represented by the results below.

Summarizing the results above we find significantly fewer smokers, more vitamin supplement users, more bachelor or higher degrees in the responding group, and these findings are consistent over age and sex groups. Responders reported higher proportion of milk consumers for both sexes, and for those 45 years and over (same pattern in 18-24 years but not significant). There was little effect of type of milk consumed, but a slight trend to lower fat milk in responders. There were no effects from marital status or bread consumption (neither proportion consuming nor bread choices).

While these results reflect statistical significance, the results need to be reviewed for practical and nutritional significance. The general direction of the differences found suggest that nutritional results may be biased towards recommendations where substantial bias is present. (See Section 8 for further discussion)

§6. Sampling Weights

6.1 Methodology

To ensure that estimates reflect population parameters correctly, sample weights are used during analysis of survey data. Sample weights account for probabilities of selection, non-response rates, and any over/under representation in the sampling frame. Statistics Canada provided information on sampling design and general instructions on sampling weights in *British Columbia Nutrition Survey - Sample design specifications, by France Bilocq, March 1999* and *British Columbia Nutrition Survey - Computing Estimation Weights, by Francois Laflamme, November 2000* (refer to Appendix B1 and B2 respectively.)

The basic weighting calculation from Appendix B is discussed in the below paragraphs. Weights for the first recall and the questionnaire forms will be developed, so the notation referring to the repeat recalls will not be included here to help simplify the formulas. Minor modifications were made to this document in order to make the weight calculations in the BCNS reflecting the different number of respondents in each season. While the 1996 post census was used to calculate the first stage selection factors, the 1999 post census for BC was used to estimate the weights to adjust for coverage problems (over/under representation of the frame).

s: season $s=1,2$

h: stratum $h= 1$ (Metro), 2 (Coaster), 3 (Non-Metro)

a: Geographic groups within the 3 strata $a=1, 2, \ldots, 11$.

i: age/gender sampling group $i=1, 2, \ldots,7$ for males

$i=8, 9, \ldots, 14$ for females

M_{ha} Number of individuals in strata "h" and geographic group "a" 1996 census

M_h: Total number of individual in BC in strata "h" 1996 census

m_h: Number of geographic group sampled in strata "h"

α_a: First stage selection factor

* for strata selected with certainty, h=1,2

$\alpha_a = 1$ ...... $a=1,2, \ldots 7$

* for strata selected with probability proportional to population size, h=3

$$\alpha_a = \frac{M_h}{M_{ha} \times m_h} \;\ldots\ldots a = 8,\ldots,11$$

N_{hai}: Number of individuals on the British Columbia Health Register (BCHR) at time of population selection in stratum *h*, geographic group *a*, age/gender group i

n_{shai}: Number of respondents in season *s*, stratum *h*, area *a*, age/gender group i

$\hat{P}_i$: Estimated size for age/gender group i.

P_i: Post census estimate of the total number individuals in age/gender group i in BC 1999 provided by Statistics Canada

(The values for stratum sizes, area sizes, α_a, and P_i can be found in Appendix B)

In general, the weights are constructed by estimating first what can be referred to as an unadjusted weight, which incorporates the first stage selection factor and the second stage weights for the respondents:

$$w^{*}_{shai} = \alpha_a \times \frac{N_{hai}}{n_{shai}} \qquad \ldots\ldots (6)$$

Using post stratification to adjust with independently known totals can help reduce the bias. Hence, a second step requires that we estimate from the survey data, the total number of individuals in the age/gender group i, say $\hat{P}_i$, and the adjust with the actual known population totals P_i. It can be shown that:

$$\hat{P}_i = \sum_a n_{hai}\ w^*_{shai} = \sum_a \alpha_a N_{hai} \qquad .....(7)$$

The final post stratified weights are:

$$w^{post}_{shai} = w^*_{shai} \times \frac{P_i}{\hat{P}_i} \qquad ......(8)$$

In this document, the post stratified weight will be referred to simply as the "weight", and denoted by w_{shai}.

Some issues become apparent with respect to the weights. Calculating the weights assumes in (6) that $n_{shai}>0$ for all *s*, *h*, *a* and *i*. From Appendix A.2, it is seen that there are many regions and age/gender groups having only one, two or no respondents at all. When numbers of respondents are small (that is n_{shai} is small in (6)), the weights can become very large, which in turn can cause a number of problems. First, it means that a few individuals will be very influential in the analysis: in light of the nonresponse rates, this may result in further distortion of the results by emphasis on a few nonrepresentative respondents. Second, large weights will add to the variability of the estimators.

As a result, we need to pool to try and keep (6) defined, and minimize the component of the variance coming from the weights. We would also like to try to minimize the bias in the estimates through construction of the weights.

There are competing issues at play in defining the pooling, or the adjustment classes. We wish to keep the groups which are going to be pooled (for the purpose of calculating weights), as homogeneous as possible with respect to their probabilities of response: this encourages many small adjustment classes. However, this can lead to large variances if the number of respondents is still so small that it leads to weights that are highly variable (one of the reasons we want to pool in the first place). It has been suggested that there should be at least 20 respondents in an adjustment class (Madow et.al. ,1983, page 45).

Another consideration when considering adjustment classes is how similar, or homogeneous, with respect to the variables of interest (Oh & Scheuren (1983) pg 155). If groups are pooled for the purpose of calculating weights where the means (or other estimates) are similar, then any differences in response probabilities that there may be, will have a smaller effect on bias (and yield a smaller mean square error).

With these issues in mind, the BCNS were examined to determine what might be sensible groups to pool. Looking at the design variables, the decision is restricted to discovering which age/gender/region groups can be pooled and still observe the above criteria. The point was to find groups with similar response probabilities.

6.2 Results

Using logistic models with the explanatory factors of season, age, sex and regions to look at the significant differences in probability of response, refused or resolved between the adjacent age groups within each season, geographic stratum and gender, it appeared that the model coefficients in adjacent age groups were sporadic and did not exhibit a consistent pattern of significant differences (refers to sections 4.2 and 4.3) . Thus, it was felt that pooling of adjacent age groups within a geographic region, season and gender would not lead to consistent bias in the estimates.

Even after pooling by adjacent age groups within a season, geographic region and sex, there were several large sample weights (>4) which are listed on table 6.1. Further collapsing of the groups was considered inappropriate so trimming was employed to reduce the size of these weights. This was accomplished by setting the large sample weights to <= 4 and adjusting the remaining weights within a season and pooled age/sex group by a common factor so that the sum of the weights remained the same. Since setting the largest sample weights to 3.6 would avoid a result of the males 18 to 39 in season 1, Coaster stratum being adjusted to a weight greater than 4, this number was thus used to adjust all weights to a value less than or equal to 3.6.

Table 6.1

LARGE SAMPLE WEIGHTS

Season	Strata	Geographic group	Age-sex group	Sample weight >4
1	Metro	Vancouver	Male 35-54	6.7332
2	Coastal	Vancouver	Male 35-54	4.3092
1	Metro	Vancouver	Female 18-34	5.9919
1	Metro	Vancouver	Female 35-54	4.9551
2	Coastal	Vancouver	Female 35-54	5.4506

§7. Comparison of Responders to Population Profiles

In section 1, it was noted that bias will be large if (1) the probability of non-response is high, or if (2) there is a large difference between the responders and nonresponders with respect to the variable of interest. Section 4 looked at the first of these component, the probability of non-response. Section 6 developed sampling weights to ensure that the responders contribute to estimates proportionally to their representation in the population (i.e., proportionally with respect to age, sex, geographic region and season). Note that weighting does not remove bias from the results.

To address the second factors, differences between the responders and refusers, ideally one would like to sample some non-responders and obtain interviews. Another option to help assess comparability, is to ask refusers at the time of recruitment some information linked to nutrition as was done in the survey and discussed in section 5 (i.e. analysis of extra questions on smoking status, milk, bread and vitamin/mineral consumption, education, marital status). This extra information was used to compare responders and refusers who would participate in the 'non-response' questions to try and get some idea of potential magnitude and direction of bias.

A third option is to look at aspects of responders which are linked to nutrition/food, and see if the responders match the general population with respect to these characteristics. Discrepancies can indicate direction and magnitude of potential bias. However, the absence of differences does not guarantee absence of bias.

In the survey, we are limited to those questions, for which population profiles are reliably available, and which have a link to nutritional status. The literature discusses many variables and factors which may be considered, but given the above constraints, analysis will focus on smoking, educational status and marital status.

Ideally, when comparing to the general population of British Columbia, data from the Census are most useful. The 1996 Census collected detailed information on education and marital status which can be directly compared to the BCNS. Unfortunately, the Census did not collect information on smoking. For comparative purposes, the 1999 Canadian Tobacco Use Monitoring Survey can be used to look at smoking prevalence in BC.

In the analysis which follows, all survey estimates are weighted by sample weights to ensure that responders contribute to estimates proportionally (with respect to age, sex) to their representation in the general population.

7.1 Smoking Status

The Canadian Tobacco Use Monitoring Survey (CTUMS) is a national survey sponsored by Health Canada, conducted by Statistics Canada to track changes in smoking status. It focuses on young adults by oversampling 15-24 year olds, though all ages15 years and up are sampled. Recruitment is carried out over the telephone, and a computer assisted interview conducted. In the Feb - Sept 1999 collection, the overall response rate was 82%. (For more information about CTUMS see http://www.hc-sc.gc.ca/hppb/tobacoo/ctums/survey.html).
In CTUMS looking only at the BC component, there were 1722 respondents ages 18 to 84, with over 40% of these respondents in the 18-24 year range. The sample allocation will limit the degree of age-specific comparisons that will be possible since there are some small sample sizes in the older groups (58 individuals 75-84 for example).

7.1.1 Results

The weighted proportions in each survey are presented in Table 7.1.[1]

Table 7.1
Population Daily Smoking Rates
Comparison of CTUMS 1999 and BCNS

Group	BC Nutrition Survey Responders		CTUMS 1999 - BC	
	Wted Proportion	N	Wted Proportion	N
All	16.9	1806	17.3	1722
Males	17.3	860	17.9	790
Females	16.5	946	16.8	932
M 18-24	17.8	85	23.9	350
M 25-44	18.7	205	20.6	213
M 45- 84	15.9	570	13.7	227
F 18-24	11.8	100	16.2	351
F 25-44	19.5	257	21.9	284
F 45-84	15.7	589	12.1	297

With these sample sizes there were no significant differences in proportion of daily smokers in the two surveys.

7.2 Marital Status

Proportions of individuals in various marital status categories from the 1996 Census were directly compared to weighted proportions for the same categories in the BCNS and tested using a chi-square test. The results are described in Tables 7.2.

In males, there were significantly higher proportion of married and single in the BCNS compared to the Census and fewer widowed, however this pattern was not consistent over all ages. Between 25-44 the key difference was in higher proportion of single men and lower proportion separated/divorced. In men 45- 84 more married and fewer widowed status dominate.

In females, a higher proportion of married women and lower proportion of single women are found from 18-54 years. In older ages, there is a lower proportion of married women than expected and higher proipotion of widows.

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[1] The BC specific CTUMS results have been generously provided through personal communication from M. de Groh, Health Canada, Jan 2002.

Table 7.2
Comparison of Proportions - Marital Status
1999 BCNS vs. 1996 Census

Age group	**Males**			**Females**		
	1996 Census Proportion	**1999 BCNS**		**1996 Census Proportion**	**1999 BCNS**	
		Proportion	**Sample size**		**Proportion**	**Sample Size**
18-24 years			85			100
Married	0.12	0.13		0.05	0.22	
Single	0.86	0.87		0.94	0.75	
Separated/divorced	0.02	0.00		0.01	0.03	
Widowed	0.00	0.00		0.00	0.00	
25-34 years			99			126
Married	0.51	0.52		0.43	0.57	
Single	0.38	0.45		0.51	0.33	
Separated/divorced	0.11	0.03		0.06	0.09	
Widowed	0.00	0.00		0.00	0.00	
35-44 years			104			131
Married	0.67	0.70		0.64	0.74	
Single	0.14	0.21		0.21	0.11	
Separated/divorced	0.18	0.09		0.14	0.15	
Widowed	0.01	0.00		0.00	0.00	
45-54 years			87			122
Married	0.68	0.87		0.73	0.78	
Single	0.07	0.03		0.09	0.01	
Separated/divorced	0.21	0.10		0.17	0.17	
Widowed	0.03	0.01		0.01	0.05	
55-64 years			94			130
Married	0.70	0.79		0.78	0.59	
Single	0.03	0.07		0.06	0.03	
Separated/divorced	0.16	0.13		0.13	0.23	
Widowed	0.11	0.01		0.03	0.15	
65-74 years			193			166
Married	0.58	0.87		0.79	0.60	
Single	0.03	0.02		0.05	0.01	
Separated/divorced	0.10	0.07		0.09	0.07	
Widowed	0.28	0.04		0.07	0.31	
75-84 years			196			173
Married	0.33	0.72		0.72	0.56	
Single	0.04	0.02		0.04	0.02	
Separated/divorced	0.06	0.06		0.06	0.04	
Widowed	0.57	0.20		0.18	0.38	
All ages			858			948
Married	0.55	0.64		0.58	0.60	
Single	0.23	0.28		0.30	0.20	
Separated/divorced	0.13	0.07		0.10	0.12	
Widowed	0.09	0.02		0.02	0.09	

7.3 Education

For each education category (secondary school; trade school or community college; some university education; and completed a bachelors degree) proportions were calculated for the Census and directly compared to weighted proportions for the same categories in BCNS and tested with chi-square tests. The results are described in Table 7.3.

The results indicate that overall, and among males and females, significant differences exist between the educational levels of respondents in the BCNS and the Census. The BCNS had a significantly lower proportion of respondents with some secondary and some trade/college education (refer to Table 7.3) and higher proportion of respondents with at least some university education. This was consistent across the age-sex groups. They all have a significantly lower proportion of respondents with secondary or some trade/college and higher proportion of respondents with at least some university education. Of particularly concern are substantial differences in the proportions of respondents with secondary and some university education (refer to table 7.3).

Looking at individuals who had completed a university degree with a bachelor degree or higher, overall, there was a significantly higher proportion of male respondents in the BCNS than expected from the Census but no statistically significant difference was observed among females (though the pattern of higher proportion was similar). These patterns were consistent across all male age groups though statistical significance was not achieved for all. For younger female age groups, there is also the trend of higher proportion with bachelor's degree or above, but statistically significance was observed for only the youngest age group 18-24.

These results lead to suggest that there is a trend towards higher education for the respondents in the BCNS compared to the Census.

Table 7.3
Comparison of Proportions - Education Level
1996 BCNS vs. 1996 Census

Age group	Males			Females		
	1996 Census Proportion	1999 BCNS Proportion	Sample Size	1996 Census	1999 BCNS	Sample Size
18-24 years			85			100
Secondary School	0.73	0.26		0.80	0.35	
Trade or College	0.17	0.17		0.13	0.14	
Some University	0.02	0.46		0.02	0.38	
Completed University	0.08	0.11		0.05	0.13	
25-34 years			101			126
Secondary School	0.44	0.27		0.47	0.25	
Trade or College	0.33	0.17		0.32	0.23	
Some University	0.03	0.27		0.02	0.27	
Completed University	0.20	0.29		0.19	0.25	
35-44 years			104			131
Secondary School	0.48	0.26		0.43	0.26	
Trade or College	0.33	0.30		0.36	0.20	
Some University	0.03	0.19		0.02	0.30	
Completed University	0.16	0.25		0.18	0.24	
45-54 years			88			123
Secondary School	0.49	0.27		0.41	0.31	
Trade or College	0.30	0.21		0.35	0.22	
Some University	0.04	0.29		0.03	0.29	
Completed University	0.16	0.24		0.21	0.18	
55-64 years			94			130
Secondary School	0.63	0.56		0.51	0.32	
Trade or College	0.25	0.16		0.32	0.22	
Some University	0.04	0.17		0.02	0.31	
Completed University	0.09	0.11		0.16	0.14	
65-74 years			192			166
Secondary School	0.73	0.48		0.61	0.53	
Trade or College	0.19	0.21		0.25	0.20	
Some University	0.03	0.14		0.03	0.17	
Completed University	0.05	0.17		0.11	0.10	
75-84 years			196			172
Secondary School	0.78	0.50		0.68	0.53	
Trade or College	0.15	0.17		0.20	0.13	
Some University	0.03	0.15		0.02	0.20	
Completed University	0.05	0.17		0.09	0.13	
All ages			860			948
Secondary School	0.57	0.33		0.52	0.34	
Trade or College	0.27	0.21		0.30	0.20	
Some University	0.03	0.26		0.02	0.28	
Completed University	0.13	0.21		0.16	0.18	

Please note: Completed University=respondents with "at least" a Bachelor's Degree

7.4. Discussion

There is a growing body of literature which links smoking behaviour and trends in nutrient and food intakes (Subar et al. 1990, Larkin et al., 1990, Morabia and Wyder 1990, McPhillips et al, 1994). In general, it is reported that daily smokers tend to have intakes of food and nutrients in the direction away from recommendations relative to nonsmokers. As a result, smoking prevalence can be a key indicator of bias in the nutritional data from the responders. The complex correlation of epidemilogical variables such as education, smoking, age, supplement use with food intake intake, suggests these as useful indicator variables (Berger and Wynder (1994)). [2]

While there was a slightly lower proportion of smokers in the BCNS than in CTUMS, none of the differences reached statistical significance. In section 5, it was noted that there were significantly fewer smokers in the responding population than in the refusing group: the impact of this pattern is likely reflected in the statistically nonsignificant but consistent pattern of slightly lower proportion of smokers in BCNS than CTUMS. This suggests that any related bias in the nutritional results likely will be small and hard to detect.

The over-representation of university education consistently in all ages and both sexes may introduce significant bias in the results of attitude, behaviour and awareness questions, particularly if they are linked to literacy. It has been reported that groups with a higher educational attainment will have lower smoking rates, lower alcohol and meat consumption but higher fruit, vegetable and supplement consumption (Berger and Wynder (1994)). In regards to educational levels, smoking patterns and supplement usage, the BCNS seemed to follow this general trend. While it was not possible to compare supplement consumption in the BCNS to the BC population, we have found that responders were more likely to report consuming supplements in the past month than refusers who filled out the 'non-response' questions (refer to section 5.4).

The distribution of marital status in the BCNS was generally not comparable to the Census. However, the nutritional significance of this departure is not clear: there is little literature in this area and study of this factor is part of the active investigation at HC noted above.

§8. Summary Discussion

The overall response rate of the BCNS lies between 42% - 52%. The lower bound rate varied from 29% for males 25-34 years to 54% for females 55-64 years. The upper bound rate varied from 44% for males 25-34 years to 60 % for females 55-64 years. Generally, lower response rates were observed among younger and oldest people, specially in the male age group 25-34 (29%), and the Prince George region (31%). Compare to other Federal-Provincial nutrition surveys in which 46% - 85% of located and eligible respondents [2], the BCNS rates are quite comparable. However, the representativeness of the younger and oldest people, and specific geographic regions (for example Prince George (31%); Terrace (37%); Nanaimo (39%)) need to be considered carefully in light of this particularly high non-response.

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[2] Very early work in Health Canada examining the relationship of these variables with nutrient intake using earlier Federal Provincial surveys seems to confirm the published literature that the indicators examined (plus the milk consumption variable) are significant factors related to intakes of many nutrients. Personal communication B. Junkins Jan 2002.

Approximately 73% of refusers who were approached, (and 66% of all classed as refusals) completed extra questions, which allowed for comparisons among responders and refusers but does not provide a complete picture of the actual potential difference or bias.

Cigarette smoking was of particular interest because of the link between smoking and nutrition behaviour (ie., daily smokers tend to have food/nutrition intakes that differ from recommended nutrition levels [4]). The proportion of daily smokers was significantly different between responders and refusers who completed the extra questions. Among daily smokers, the average number of cigarettes smoked per day between responders and refusers were similar. Smoking information collected from the BCNS survey was also compared with smoking information CTUMS. While BCNS had slightly lower smoking rates, none reached statistical significance. This suggests that any related bias in the nutritional results likely will be small and hard to detect.

Bread, milk and vitamin-mineral consumption habits were examined via extra questions posed to respondents and refusers. There were no significantly differences in the proportion of responders and refusers relating to prevalence of bread consumption or type of bread consumed. A significantly larger proportion of responders were milk consumers and there was a slight trend to lower fat milks in responders. The proportion consuming vitamin - mineral supplements was also significantly higher in the responding population. These results suggest that prevalence of milk and vitamin consumption may be slightly high from the survey, and nutrients related to milk consumption may be biased towards lower fat intakes.

The distribution of marital status was significantly different between the BCNS and the population data but the nutritional significance of this departure is not clear. The proportion of university educated people in the survey was significantly higher than the Census (refer to section 7.3), especially among men and younger women. The education profile may bias nutritional results toward the recommendations, and may effect attitude, behaviour and awareness questions, particularly if they are linked to literacy.

All of the results that reach statistical significance should be assessed for nutritional and biological significance. When comparing to other surveys, or historical data, these characteristics of the responding population should be kept in mind.

There is no acceptable or unacceptable level of non-response: the actual percent deemed acceptable depends on the survey objectives. As noted by the National Research Council, National Academy of Science, even in a specific survey such a level would be difficult to specify. (Madow et al, 1983 pg5-6). In general, rates should be kept low, and as noted by the NRC, non-response must be planned for and dealt with, measured and reported.

There is no weighting scheme which will remove systematic non-response biases if they are present. When publishing or releasing data from the BCNS, it will be important to disclose fully to all users the various rates and instruct researchers to interpret the data keeping in mind the potential effects of non-response bias.

9. References

1. Annual Demographic Statistics, 1996, Statistics Canada, Catalogue no. 91-213-XPB

2. Analysis of Non-response, Alberta Nutrition Survey 1994, Report BBCA 451311-006NR, July 1999, B. Junkins, Bureau of Biostatistics and Computer Applications, Food Directorate, Health Canada

3 Incomplete Data in Sample Surveys, 1983, Vol 1, Chapter 3, editors W. Madow, H. Nisselson, I. Olkin

4. Berger, J., and Wynder, E (1994) The correlation of Epidemiological Variables. *J. Clinical Edi* **47**, pp 941-952.

5. Larkin, F.A., P.P. Basiotis, H.A. Riddick, K.E. Sykes, E.M. Pao (1990) Dietary patterns of women smokers and non-smokers. J. Am. Diet. Assoc. Vol. 90, No. 2, pp 230-237.

6. McPhillips, J.B., C.B. Eaton, K.M. Gans, C.A. Derby, T.M. Lasater, J.L. McKenney, R.A. Carleton (1994) Dietary differences in smokers and nonsmokers from two southeastern New England communities. J. Am. Diet. Assoc. 94 (3) pp 287-92.

7. Morabia, A. and E.L. Wynder (1990) Dietary habits of smokers, people who never smoked, and exsmokers. (1990) Am. J. Clin. Nutr. 52: 933-7.

8. National Population Health Survey, Statistics Canada, Catalogue no. 32-221-XDE

9. British Columbia Nutrition Survey, Project Resource and Training Manual, March 1995

10. Standards and Guidelines for Reporting of Non-response Rates: Definitions, Framework and Detailed Guidelines, Statistics Canada Methods and Standards Committee (1992)

11. Subar, A.F., L.C. Harlan, M.E. Mattson (1990) Food and Nutrient Intake Differences between Smokers and Non-smokers in the US. Am. J. Public Health 80: 1323-1329

12. 1996 Census, Statistics Canada, Population 15 Years and Over by Sex and Detailed Highest Level of Schooling, 8_T1.IVT

Appendix A

Detailed Tables

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§A1 Definition of Response Categories

The detailed entries on the questionnaires were considered for classification into one of the categories below. The Statistics Canada "Standards Guidelines" for each of the response categories was used as the basis for the classification.

1. Response
   a) Responds and usable record
   b) Responds and unuseable

2. Nonresponding Units
   a) Refusals
      ~ refused, no information
      ~ direct "NO"
      ~ indirect, "too busy", "I will call later", respondent later cancelled, respondent not show up, "not available"
   b) No Contact
      ~ verified location but not able to contact
   c) Residual
      ~ respondent drunk
      ~ not accessible during appointment time
      ~ language
      ~ interviewer had to cancel due to illness or weather
      ~ one of the interviewers drawn in the sample
      ~ sibling completed the interview
      ~ not safe for interviewer
      ~ ill, handicapped
      ~ third party refuse
   d) Incomplete/Unreliable/Unusable Recall

3. Out of Scope
   a) Nonexistent units ~ dead
   b) Temporarily out of scope
      ~ pregnant or nursing
      ~ hospitalized
      ~ seasonally nonresident (during interview period)
      ~ military base
   c) Permanently out of scope
      ~ Moved out of province
      ~ Institution or reserve
      ~ moved within province but not in any sampling areas
      ~ over 85 years old
      ~ disabled

4. Unresolved
    a) Moved within the province, within the sampling areas but not tracked down further
    b) Letter returned, no answer after 6 calls, cannot locate by phone or home visit
    c) Unresolved after less than 6 tries, insufficient time to continue follow up

5. Never attempted to contact ~ ran out of time
6. Removed from frame - special

A2.2: Fall 1999 - first and second reliable interviews by age, sex and geographic area.

Sampling Geographic Region	Age-Sex Group																													
	M 18-24		M 25-34		M 35-44		M 45-54		M 55-64		M 65-74		M 75-84		F 18-24		F 25-34		F 35-44		F 45-54		F 55-64		F 65-74		F 75-84		All	
	first	repeat	first	repeat	first	repeat	first	repeat	first	repeat	first	repeat	first	repeat	first	repeat	first	repeat	first	repeat	first	repeat	first	repeat	first	repeat	first	repeat	first	repeat
Vancouver	14	4	9	3	8	1	7	2	8	2	18	7	15	6	5	2	5	5	8	1	14	7	11	4	14	4	15	3	157	46
Victoria	5	0	4	0	2	0	2	0	3	1	6	3	8	2	3	1	4	0	3	0	4	1	7	0	8	1	7	2	67	11
Nanaimo	1	0	3	1	2	1	1	0	5	0	5	1	4	1	2	0	1	8	5	1	2	1	2	0	8	1	3	0	41	10
Kamloops	1	0	1	0	4	1	1	0	1	0	6	1	6	1	2	1	4	7	5	1	4	0	2	1	1	0	4	2	44	12
Kelowna	1	0	1	0	4	0	3	2	1	1	8	1	7	2	2	0	3	1	2	0	10	2	6	2	6	1	3	1	53	11
Prince George	3	2	5	2	1	0	3	1	2	0	5	5	5	2	4	3	4	2	6	2	3	0	1	1	4	2	3	0	46	14
Coastal	10	1	4	0	3	1	10	3	8	3	19	4	29	8	14	4	14	5	13	3	14	3	14	3	18	4	21	9	185	51
Kootenay	2	1	7	1	3	2	3	1	4	2	3	2	12	1	2	2	5	0	1	2	4	1	4	2	4	3	7	3	73	19
Chilliwack	2	3	4	2	6	1	2	1	2	3	3	2	3	1	3	1	4	3	3	0	3	3	4	1	2	0	7	1	53	11
Vernon	2	2	6	1	5	1	5	3	4	1	9	4	8	3	5	3	12	4	4	2	5	2	8	2	6	0	8	2	86	26
Terrace	4	2	4	2	5	1	3	0	6	1	8	2	4	2	2	8	3	1	6	1	8	1	8	1	5	4	8	2	63	18
All Regions	44	12	48	9	48	9	42	12	44	12	95	29	98	24	41	10	45	19	42	19	48	15	49	15	58	20	66	25	868	229

A.2.1 Spring 1999 - first and second reliable interviews by age, sex and geographic area.

	Age-Sex Group																												All	
	M 18-24		M 25-34		M 35-44		M 45-54		M 55-64		M 65-74		M 75-84		F 18-24		F 25-34		F 35-44		F 45-54		F 55-64		F 65-74		F 75-84			
Sampling Geographic Region	first	repeat	first	repeat	first	repeat	first	repeat	first	repeat	first	repeat	first	repeat	first	repeat	first	repeat	first	repeat	first	repeat	first	repeat	first	repeat	first	repeat	first	repeat
Vancouver	12	9	10	1	17	4	8	8	13	2	14	9	13	4	16	7	8	2	12	7	8	2	3	8	19	4	3	2	165	41
Victoria	6	4	5	1	6	1	6	1	9	2	9	2	11	2	6	1	5	7	9	1	6	1	5	1	8	0	7	1	83	20
Nanaimo	2	1	4	0	4	0	2	0	2	1	4	2	6	2	1	0	4	0	2	1	3	1	5	0	5	1	8	2	54	11
Kamloops	2	0	5	1	4	1	0	1	2	1	4	0	1	1	3	1	2	1	4	0	3	1	7	1	10	1	5	1	63	15
Kelowna	3	0	4	1	6	2	5	1	6	1	6	1	8	2	0	0	5	1	0	1	1	6	2	0	4	1	6	0	65	13
Prince George	2	0	1	0	-1	-1	2	1	2	1	0	1	4	0	1	1	1	0	4	1	1	0	4	1	4	1	3	2	37	9
Coastal	18	9	14	6	20	4	9	1	19	5	24	6	21	9	21	9	22	10	19	8	22	9	12	6	21	5	23	8	237	76
Kootenay	2	1	4	1	2	1	4	1	2	0	3	2	4	2	2	0	2	1	0	1	4	0	3	1	1	0	5	2	47	14
Chilliwack	2	0	2	0	4	1	4	1	9	1	8	0	1	1	4	1	2	1	1	1	2	0	0	1	4	1	8	1	63	17
Vernon	2	0	3	1	5	2	3	2	6	3	4	2	11	3	6	3	8	1	4	1	4	1	2	1	10	0	6	3	85	20
Terrace	2	1	4	1	6	0	3	0	3	0	7	3	10	3	1	0	7	1	4	1	9	1	7	0	4	1	5	0	55	14
All Regions	45	12	54	11	61	17	46	12	51	12	80	27	101	28	59	15	64	17	58	14	61	17	47	27	66	15	87	22	955	250

A3.1: Accountability table by age and sex group

		sampling age-sex groups														
		18-24 M	25-34 M	35-44 M	45-54 M	55-64 M	65-74 M	75-84 M	18-24 F	25-34 F	35-44 F	45-54 F	55-64 F	65-74 F	75-84 F	Total
Status: drawn	num	452	825	754	233	271	429	551	346	442	365	294	245	695	724	5173
Attempted	num	329	593	527	242	247	417	480	332	415	314	262	239	403	489	4899
Resolved	num	236	279	229	231	258	332	480	245	294	254	229	224	390	640	4239
In scope	num	184	232	221	192	185	345	313	284	232	227	216	215	624	877	3889
Interviewed	num	85	152	105	89	95	216	211	150	128	150	124	170	143	173	1820
Reliable complete response	num	85	98	116	88	95	150	196	120	224	150	123	131	180	131	1748
Reliable partial response	num	6	3	2	1	2	4	8	11	2	1	6	6	4	5	23

A3.2: Accountability table by geographic area

		Sampled Region											
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Total
Screened	num	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Assigned	num	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Declined	num	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
In scope	num	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Interviewed	num	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Reliable complete response	num	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Reliable partial response	num	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

A4.1.1: Resolved rates by geographic area

	season					
	Spring 99		Fall 99		Both	
	Resolved Rate	n	Resolved Rate	n	Resolved Rate	n
Geographic region						
Vancouver	0.78	405	0.83	446	0.80	851
Victoria	0.80	194	0.79	219	0.80	413
Nanaimo	0.78	134	0.74	134	0.76	268
Kamloops	0.77	143	0.77	146	0.77	289
Kelowna	0.96	98	0.83	162	0.88	260
Prince George	0.75	147	0.71	146	0.73	293
Coastal	0.81	541	0.81	593	0.81	1134
Kootenay	0.90	171	0.85	107	0.88	278
Chilliwack	0.85	185	0.89	180	0.87	365
Vernon	0.88	191	0.89	188	0.89	379
Terrace	0.83	188	0.83	181	0.83	369
All regions	0.82	2397	0.82	2502	0.82	4899

Note: "n" reflects the number in the denominator for the equations in §3.1.2

A4.1.2: Resolved rates by age and sex group

	season					
	Spring 99		Fall 99		Both	
Sampling Age Sex Group	Resolved Rate	n	Resolved Rate	n	Resolved Rate	n
M 18-24	0.74	160	0.69	169	0.72	329
M 25-34	0.72	196	0.69	194	0.71	390
M 35-44	0.73	150	0.71	167	0.72	317
M 45-54	0.82	123	0.79	139	0.81	262
M 55-54	0.79	112	0.82	135	0.81	247
M 65-74	0.91	208	0.91	202	0.91	410
M 75-84	0.91	238	0.92	242	0.92	480
F 18-24	0.72	159	0.76	172	0.74	331
F 25-34	0.71	205	0.72	206	0.72	411
F 35-44	0.81	159	0.78	160	0.79	319
F 45-54	0.90	125	0.86	136	0.88	261
F 55-64	0.88	131	0.92	118	0.90	249
F 65-74	0.87	194	0.89	215	0.88	409
F 75-84	0.90	237	0.92	247	0.91	484
Total	0.82	2397	0.82	2502	0.82	4899

Note: "n" reflects the number in the denominator for the equations in §3.1.2

A4.2.1: In scope rates by geographic area.

*	season					
	Spring 99		Fall 99		Both	
	In Scope Rate	n	In Scope Rate	n	In Scope Rate	n
Geographic region						
Vancouver	0.90	315	0.89	368	0.89	683
Victoria	0.87	156	0.86	173	0.86	329
Nanaimo	0.90	105	0.89	99	0.89	204
Kamloops	0.87	110	0.88	112	0.87	222
Kelowna	0.91	94	0.90	135	0.91	229
Prince George	0.87	110	0.86	104	0.86	214
Coastal	0.88	438	0.89	483	0.88	921
Kootenay	0.87	154	0.85	91	0.86	245
Chilliwack	0.81	158	0.78	161	0.79	319
Vernon	0.89	169	0.83	168	0.86	337
Terrace	0.83	156	0.85	150	0.84	306
All regions	0.87	1965	0.87	2044	0.87	4009

Note: "n" reflects the number in the denominator for the equations in §3.1.2

A4.2.2: In scope rates by age-sex group

```
--------------------------------------------------------------------
|            |                      season                         |
|            |-----------------------------------------------------|
|            |    Spring 99    |     Fall 99     |      Both       |
|            |-----------------+-----------------+-----------------|
|            |  In Scope  |    |  In Scope  |    |  In Scope  |    |
|            |    Rate    | n  |    Rate    | n  |    Rate    | n  |
|------------+------------+----+------------+----+------------+----|
|Sampling Age|            |    |            |    |            |    |
|Sex Group   |            |    |            |    |            |    |
|------------|            |    |            |    |            |    |
|M 18-24     |        0.81| 119|        0.77| 117|        0.79| 236|
|------------+------------+----+------------+----+------------+----|
|M 25-34     |        0.84| 142|        0.84| 134|        0.84| 276|
|------------+------------+----+------------+----+------------+----|
|M 35-44     |        0.93| 110|        0.92| 119|        0.92| 229|
|------------+------------+----+------------+----+------------+----|
|M 45-54     |        0.92| 101|        0.90| 110|        0.91| 211|
|------------+------------+----+------------+----+------------+----|
|M 55-54     |        0.90|  89|        0.95| 111|        0.93| 200|
|------------+------------+----+------------+----+------------+----|
|M 65-74     |        0.92| 189|        0.93| 183|        0.93| 372|
|------------+------------+----+------------+----+------------+----|
|M 75-84     |        0.85| 217|        0.84| 223|        0.85| 440|
|------------+------------+----+------------+----+------------+----|
|F 18-24     |        0.74| 114|        0.76| 131|        0.75| 245|
|------------+------------+----+------------+----+------------+----|
|F 25-34     |        0.79| 146|        0.72| 148|        0.76| 294|
|------------+------------+----+------------+----+------------+----|
|F 35-44     |        0.88| 128|        0.92| 125|        0.90| 253|
|------------+------------+----+------------+----+------------+----|
|F 45-54     |        0.96| 112|        0.93| 117|        0.94| 229|
|------------+------------+----+------------+----+------------+----|
|F 55-64     |        0.99| 115|        0.94| 108|        0.96| 223|
|------------+------------+----+------------+----+------------+----|
|F 65-74     |        0.88| 169|        0.92| 191|        0.90| 360|
|------------+------------+----+------------+----+------------+----|
|F 75-84     |        0.86| 214|        0.85| 227|        0.85| 441|
|------------+------------+----+------------+----+------------+----|
|Total       |        0.87|1965|        0.87|2044|        0.87|4009|
--------------------------------------------------------------------
```

Note: “n” reflects the number in the denominator for the equations in §3.1.2

A.4.3.1: Refusal rates by geographic region.

	season					
	Spring 99		Fall 99		Both	
Geographic region	Refusal Rate	n	Refusal Rate	n	Refusal Rate	n
Vancouver	0.34	283	0.31	327	0.32	610
Victoria	0.39	136	0.33	148	0.36	284
Nanaimo	0.49	94	0.32	88	0.41	182
Kamloops	0.42	96	0.29	98	0.35	194
Kelowna	0.35	86	0.43	122	0.40	208
Prince George	0.43	96	0.39	89	0.41	185
Coastal	0.41	384	0.35	430	0.38	814
Kootenay	0.38	134	0.32	77	0.36	211
Chilliwack	0.53	128	0.39	125	0.46	253
Vernon	0.40	150	0.32	140	0.36	290
Terrace	0.41	129	0.46	128	0.44	257
All regions	0.41	1716	0.35	1772	0.38	3488

Note: "n" reflects the number in the denominator for the equations in §3.1.2

A.4.3.2: Refusal rates by age and sex groups.

	season					
	Spring 99		Fall 99		Both	
	Refusal Rate	n	Refusal Rate	n	Refusal Rate	n
Sampling Age Sex Groups						
M 18-24	0.39	96	0.43	90	0.41	186
M 25-34	0.50	119	0.32	113	0.41	232
M 35-44	0.46	102	0.37	109	0.41	211
M 45-54	0.45	93	0.42	99	0.44	192
M 55-54	0.40	80	0.37	105	0.38	185
M 65-74	0.38	174	0.32	171	0.35	345
M 75-84	0.41	185	0.33	188	0.37	373
F 18-24	0.44	84	0.28	99	0.36	183
F 25-34	0.34	116	0.35	106	0.35	222
F 35-44	0.41	112	0.33	115	0.37	227
F 45-54	0.34	107	0.39	109	0.37	216
F 55-64	0.32	114	0.29	101	0.31	215
F 65-74	0.42	149	0.34	175	0.38	324
F 75-84	0.44	185	0.40	192	0.42	377
Total	0.41	1716	0.35	1772	0.38	3488

Note: "n" reflects the number in the denominator for the equations in §3.1.2

A.4.4.1: Response rates by geographic area

	season					
	Spring 99		Fall 99		Both	
	Response Rate	n	Response Rate	n	Response Rate	n
Geographic region						
Vancouver	0.42	373	0.41	405	0.41	778
Victoria	0.39	174	0.43	194	0.41	368
Nanaimo	0.33	123	0.44	123	0.39	246
Kamloops	0.34	129	0.48	132	0.41	261
Kelowna	0.59	90	0.40	149	0.47	239
Prince George	0.35	133	0.28	131	0.31	264
Coastal	0.38	487	0.44	540	0.41	1027
Kootenay	0.48	151	0.51	93	0.49	244
Chilliwack	0.34	155	0.48	144	0.41	299
Vernon	0.50	172	0.54	160	0.52	332
Terrace	0.39	161	0.35	159	0.37	320
All regions	0.40	2148	0.43	2230	0.42	4378

Note: "n" reflects the number in the denominator for the equations in §3.1.2

A.4.4.2: Response rates by age-sex group

	season					
	Spring 99		Fall 99		Both	
	Response Rate	n	Response Rate	n	Response Rate	n
Sampling Age Sex Groups						
M 18-24	0.32	137	0.29	142	0.30	279
M 25-34	0.28	173	0.31	173	0.29	346
M 35-44	0.32	142	0.38	157	0.35	299
M 45-54	0.37	115	0.36	128	0.37	243
M 55-54	0.43	103	0.40	129	0.41	232
M 65-74	0.49	193	0.52	190	0.51	383
M 75-84	0.48	206	0.50	207	0.49	413
F 18-24	0.32	129	0.42	140	0.37	269
F 25-34	0.37	175	0.38	164	0.38	339
F 35-44	0.43	143	0.46	150	0.45	293
F 45-54	0.53	120	0.47	128	0.50	248
F 55-64	0.48	130	0.60	111	0.54	241
F 65-74	0.41	174	0.49	199	0.45	373
F 75-84	0.41	208	0.41	212	0.41	420
Total	0.40	2148	0.43	2230	0.42	4378

Note: "n" reflects the number in the denominator for the equations in §3.1.2

A.4.4.3 : Response Rates ~ Lower Bound on Analysis
Geographic region summary

	season					
	Spring 99		Fall 99		Both	
	Response Rate	n	Response Rate	n	Response Rate	n
Geographic region						
Vancouver	0.42	373	0.41	405	0.41	778
Victoria	0.39	174	0.43	194	0.41	368
Nanaimo	0.33	123	0.44	123	0.39	246
Kamloops	0.34	129	0.48	132	0.41	261
Kelowna	0.59	90	0.40	149	0.47	239
Prince George	0.35	133	0.28	131	0.31	264
Coastal	0.38	487	0.44	540	0.41	1027
Kootenay	0.48	151	0.51	93	0.49	244
Chilliwack	0.34	155	0.48	144	0.41	299
Vernon	0.50	172	0.53	160	0.52	332
Terrace	0.39	161	0.35	159	0.37	320
All regions	0.40	2148	0.43	2230	0.42	4378

Note: “n” reflects the number in the denominator for the equations in §3.1.2

A.4.4.4: Response Rates ~ Lower Bound on Analysis Age-Sex Summary

	season					
	Spring 99		Fall 99		Both	
	Response Rate	n	Response Rate	n	Response Rate	n
Sampling Age Sex Groups						
M 18-24	0.32	137	0.29	142	0.30	279
M 25-34	0.28	173	0.31	173	0.29	346
M 35-44	0.32	142	0.38	157	0.35	299
M 45-54	0.37	115	0.36	128	0.36	243
M 55-54	0.43	103	0.40	129	0.41	232
M 65-74	0.49	193	0.52	190	0.51	383
M 75-84	0.48	206	0.49	207	0.48	413
F 18-24	0.32	129	0.42	140	0.37	269
F 25-34	0.37	175	0.38	164	0.38	339
F 35-44	0.43	143	0.46	150	0.45	293
F 45-54	0.53	120	0.47	128	0.50	248
F 55-64	0.48	130	0.60	111	0.54	241
F 65-74	0.41	174	0.49	199	0.45	373
F 75-84	0.41	208	0.41	212	0.41	420
Total	0.40	2148	0.43	2230	0.42	4378

Note: "n" reflects the number in the denominator for the equations in §3.1.2

A.4.4.5: Response Rates ~ Upper Bound on Analysis
Geographic region summary

	season					
	Spring 99		Fall 99		Both	
	Response Rate	n	Response Rate	n	Response Rate	n
Geographic region						
Vancouver	0.55	283	0.50	327	0.53	610
Victoria	0.49	136	0.56	148	0.53	284
Nanaimo	0.44	94	0.61	88	0.52	182
Kamloops	0.46	96	0.64	98	0.55	194
Kelowna	0.62	86	0.49	122	0.54	208
Prince George	0.48	96	0.42	89	0.45	185
Coastal	0.48	384	0.55	430	0.52	814
Kootenay	0.54	134	0.61	77	0.57	211
Chilliwack	0.41	128	0.55	125	0.48	253
Vernon	0.57	150	0.61	140	0.59	290
Terrace	0.49	129	0.43	128	0.46	257
All regions	0.51	1716	0.54	1772	0.52	3488

Note: "n" reflects the number in the denominator for the equations in §3.1.2

A.4.4.6: Response Rates ~ Upper Bound on Analysis
Age-Sex Summary

	season					
	Spring 99		Fall 99		Both	
	Response Rate	n	Response Rate	n	Response Rate	n
Sampling Age Sex Groups						
M 18-24	0.46	96	0.46	90	0.46	186
M 25-34	0.40	119	0.48	113	0.44	232
M 35-44	0.44	102	0.55	109	0.50	211
M 45-54	0.45	93	0.46	99	0.46	192
M 55-54	0.55	80	0.49	105	0.51	185
M 65-74	0.55	174	0.58	171	0.56	345
M 75-84	0.53	185	0.54	188	0.53	373
F 18-24	0.49	84	0.60	99	0.55	183
F 25-34	0.56	116	0.59	106	0.58	222
F 35-44	0.55	112	0.60	115	0.58	227
F 45-54	0.60	107	0.55	109	0.57	216
F 55-64	0.55	114	0.66	101	0.60	216
F 65-74	0.48	149	0.56	175	0.52	324
F 75-84	0.46	185	0.45	192	0.46	377
Total	0.51	1716	0.54	1772	0.52	3488

Note: “n” reflects the number in the denominator for the equations in §3.1.2

Appendix A5 Detailed Extra Question Results

Table A5.1
Proportion Reporting Bread Consumption

	RESPONSE CATEGORY			
	Responder		Refuser	
		EAT BRD		EAT BRD
	N	Percent	N	Percent
ALL	1809	98.9	874	98.5
SEX				
Male	860	99.2	431	98.6
Female	949	98.7	443	98.4
AGE SEX GROUP				
M 18-24 yrs	85	98.8	46	100.0
M 25-34 yrs	101	99.0	61	98.4
M 35-44 yrs	104	100.0	60	100.0
M 45-54 yrs	88	98.9	60	98.3
M 55-64 yrs	94	98.9	46	97.8
M 65-74 yrs	192	99.0	78	98.7
M 75-84 yrs	196	99.5	80	97.5
F 18-24 yrs	100	100.0	40	100.0
F 25-34 yrs	126	97.6	48	97.9
F 35-44 yrs	131	96.9	47	100.0
F 45-54 yrs	123	99.2	53	100.0
F 55-64 yrs	130	99.2	48	100.0
F 65-74 yrs	166	100.0	96	95.8
F 75-84 yrs	173	98.3	111	98.2

Table A5.2
Proportion Reporting by Bread Type

	RESPONSE CATEGORY													
	Responder							Refuser						
		WHOLE WHEAT	WHITE	MULTIGR-AIN	RYE-PUMP	OTH	NOT KNOW		WHOLE WHEAT	WHITE	MULTIGR-AIN	RYE-PUMP	OTH	NOT KNOW
	N	Percent	Percent	Percent	Percent	Percent	Percent	N	Percent	Percent	Percent	Percent	Percent	Percent
ALL	1790	49.7	23.7	17.5	4.8	4.1	0.1	861	51.0	24.4	13.7	4.6	5.2	0.8
SEX														
Male	853	51.1	25.6	13.6	5.5	4.1	0.1	425	51.3	28.2	11.1	4.2	4.0	1.2
Female	937	48.5	22.1	21.1	4.2	4.2	0.0	436	50.7	20.6	16.3	5.0	6.4	0.5
AGE SEX GROUP														
M 18-24 yrs	84	46.4	34.5	11.9	2.4	4.8	0.0	46	45.7	41.3	6.5	4.3	2.2	0.0
M 25-34 yrs	100	49.0	33.0	13.0	1.0	3.0	1.0	60	56.7	26.7	13.3	0.0	3.3	0.0
M 35-44 yrs	104	51.9	28.8	13.5	3.8	1.9	0.0	60	51.7	33.3	8.3	1.7	5.0	0.0
M 45-54 yrs	87	44.8	26.4	18.4	8.0	2.3	0.0	59	37.3	37.3	20.3	1.7	1.7	1.7
M 55-64 yrs	93	49.5	22.6	14.0	6.5	7.5	0.0	45	57.8	31.1	11.1	0.0	0.0	0.0
M 65-74 yrs	190	53.7	20.5	14.7	6.3	4.7	0.0	77	50.6	20.8	10.4	10.4	6.5	1.3
M 75-84 yrs	195	54.9	22.1	11.3	7.7	4.1	0.0	78	57.7	16.7	7.7	7.7	6.4	3.8
F 18-24 yrs	100	42.0	35.0	17.0	2.0	4.0	0.0	40	35.0	40.0	15.0	2.5	5.0	0.0
F 25-34 yrs	123	43.9	30.1	20.3	1.6	4.1	0.0	47	53.2	19.1	19.1	2.1	4.3	2.1
F 35-44 yrs	127	39.4	24.4	26.8	2.4	7.1	0.0	47	48.9	23.4	19.1	4.3	2.1	0.0
F 45-54 yrs	122	48.4	18.9	23.8	5.7	3.3	0.0	53	50.9	26.4	15.1	5.7	1.9	0.0

```
|F 55-64 yrs     | 129|    41.1|    18.6|    26.4|     7.0|     7.0|     0.0|  48|    45.8|    12.5|    18.8|     8.3|    14.6|     0.0|
|----------------+----+--------+--------+--------+--------+--------+--------+----+--------+--------+--------+--------+--------+--------|
|F 65-74 yrs     | 166|    51.8|    15.1|    24.1|     6.0|     3.0|     0.0|  92|    53.3|    16.3|    14.1|     6.5|     9.8|     0.0|
|----------------+----+--------+--------+--------+--------+--------+--------+----+--------+--------+--------+--------+--------+--------|
|F 75-84 yrs     | 170|    64.7|    18.8|    11.2|     3.5|     1.8|     0.0| 109|    56.0|    17.4|    15.6|     4.6|     5.5|     0.9|
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Table A5.3
Proportion Reporting Milk Consumption

	RESPONSE CATEGORY			
	Responder		Refuser	
		DRK MILK		DRK MILK
	N	Percent	N	Percent
ALL	1809	94.6	876	89.4
SEX				
Male	860	92.7	432	88.9
Female	949	96.3	444	89.9
AGE SEX GROUP				
M 18-24 yrs	85	91.8	47	93.6
M 25-34 yrs	101	90.1	61	93.4
M 35-44 yrs	104	94.2	60	95.0
M 45-54 yrs	88	94.3	60	86.7
M 55-64 yrs	94	89.4	45	80.0
M 65-74 yrs	192	93.2	78	84.6
M 75-84 yrs	196	93.9	81	88.9
F 18-24 yrs	100	97.0	40	85.0
F 25-34 yrs	126	95.2	48	95.8
F 35-44 yrs	131	92.4	47	95.7
F 45-54 yrs	123	95.9	54	88.9
F 55-64 yrs	130	96.9	48	89.6
F 65-74 yrs	166	98.8	96	88.5
F 75-84 yrs	173	97.1	111	88.3

Table A5.4
Proportion Reporting by Milk Type

	RESPONSE CATEGORY													
	Responder							Refuser						
		SKIM	1 %	2 %	WHOLE	OTH	NOT KNOW		SKIM	1 %	2 %	WHOLE	OTH	NOT KNOW
	N	Percent	Percent	Percent	Percent	Percent	Percent	N	Percent	Percent	Percent	Percent	Percent	Percent
ALL	1711	17.0	24.3	43.0	10.5	5.1	0.1	783	15.3	23.8	44.4	13.3	2.9	0.3
SEX														
Male	797	13.4	23.0	46.9	11.5	5.1	0.0	384	11.5	22.7	47.1	15.4	3.4	0.0
Female	914	20.1	25.5	39.6	9.5	5.1	0.1	399	19.0	24.8	41.9	11.3	2.5	0.5
AGE SEX GROUP														
M 18-24 yrs	78	2.6	30.8	50.0	10.3	6.4	0.0	44	9.1	34.1	40.9	15.9	0.0	0.0
M 25-34 yrs	91	14.3	26.4	48.4	8.8	2.2	0.0	57	19.3	22.8	36.8	19.3	1.8	0.0
M 35-44 yrs	98	17.3	33.7	36.7	9.2	3.1	0.0	57	10.5	29.8	42.1	17.5	0.0	0.0
M 45-54 yrs	83	20.5	21.7	48.2	4.8	4.8	0.0	52	9.6	9.6	63.5	15.4	1.9	0.0
M 55-64 yrs	84	8.3	21.4	53.6	10.7	6.0	0.0	36	13.9	19.4	52.8	5.6	8.3	0.0
M 65-74 yrs	179	15.6	21.2	42.5	15.1	5.6	0.0	66	10.6	25.8	37.9	21.2	4.5	0.0
M 75-84 yrs	184	12.5	15.2	51.1	14.7	6.5	0.0	72	8.3	18.1	56.9	9.7	6.9	0.0
F 18-24 yrs	97	27.8	26.8	35.1	6.2	4.1	0.0	34	17.6	29.4	47.1	5.9	0.0	0.0
F 25-34 yrs	120	22.5	29.2	32.5	13.3	2.5	0.0	46	28.3	28.3	32.6	10.9	0.0	0.0
F 35-44 yrs	121	16.5	32.2	32.2	11.6	7.4	0.0	45	17.8	22.2	46.7	11.1	2.2	0.0
F 45-54 yrs	118	16.1	25.4	47.5	5.9	4.2	0.8	48	12.5	35.4	45.8	6.3	0.0	0.0
F 55-64 yrs	126	23.0	26.2	34.9	9.5	6.3	0.0	43	25.6	34.9	30.2	4.7	4.7	0.0
F 65-74 yrs	164	21.3	22.0	43.9	7.9	4.9	0.0	85	20.0	22.4	42.4	11.8	3.5	0.0
F 75-84 yrs	168	16.1	20.2	46.4	11.3	6.0	0.0	98	15.3	15.3	44.9	18.4	4.1	2.0

Appendix 2

Criteria Used to Establish the Estimated Average Requirement (EAR), Adequate Intake (AI), and the Tolerable Upper Intake Level (UL) for the Adult Non-pregnant, Non-lactating Population

Appendix Q: Criteria used to Establish the Estimated Average Requirement (EAR), Adequate Intake (AI) and the Tolerable Upper Intake Level (UL) for the Adult, Non-pregnant, Non-lactating Population

Nutrient	Criterion EAR	Criterion AI	Criterion UL
Carbohydrate	Brain glucose utilization	————	————
α-Linolenic Acid	————	Median intake from Continuing Food Survey II	————
Linoleic Acid	————	Median intake from Continuing Food Survey II	————
Protein	Nitrogen equilibrium	————	————
Folate	Intake needed to maintain red blood cell folate levels.	————	Applies to synthetic forms of folic acid and is based on the examination of case reports of progression of neurological effects in vitamin B12 deficient patients taking folate supplements.
Niacin	Relates intake to urinary excretion of niacin metabolites.	————	Based on the adverse affect of flushing.
Panothenic Acid	————	Intake sufficient to replace urinary output.	————
Riboflavin	Indicators include urinary output of riboflavin and its metabolites, blood levels of riboflavin, and erythrocyte glutathione reductase activity coefficient.	————	————
Thiamin	Maintain normal erythrocyte transketolase activity.	————	————
Vitamin B6	Intake needed for maintenance of plasma pyridoxal phosphate levels.	————	Based on the adverse affect of sensory neuropathy.
Vitamin B12	Intake needed for maintenance of hematological status and serum B12 levels.	————	————
Vitamin C	Ages 19-30 years: Near maximal neutrophil concentration. Ages 31 plus: extrapolation of near maximal neutrophil concentrations from 19-30 years.	————	Applies to intakes from food and supplements and based on adverse effect of osmotic diarrhea.

Appendix Q: Continued

Nutrient	**Criterion EAR**	**Criterion AI**	**Criterion UL**
Calcium	————	Ages 19-30 years: Desirable calcium retention/factorial. Ages 31-50 years: Calcium balance. Ages 51-70 years: Desirable calcium retention/factorial/change in bone mineral density. Ages 71 plus: Extrapolation of desirable calcium retention from 51 to 70/change in bone mineral density/fracture rate.	————
Iron	Factorial modelling	————	Based on gastrointestinal distress
Magnesium	Ages 19-70 years: Balance studies. Ages 71 plus: Intracellular studies/ decreases in absorption.	————	Applies to pharmacological sources only.
Phosphorus	Ages 19-50 years: serum inorganic phosphate levels. Ages 51 plus: Extrapolation of serum inorganic phosphate levels from 19-50 years.	————	Based on the effects of hyperphosphatemia
Zinc	Factorial approach-minimal quantity of absorbed zinc adequate to replace endogenous losses.	————	Reduction in erythrocyte copper-zinc superoxide dismutase activity
Fibre	————	Based on the greatest reduction in risk for coronary heart disease and set at 14 g/1000kcal x median energy intake [kcal/1000 kcal/d] for each age and gender group.	————

Appendix R

Median Usual Intakes of United States Population

Appendix R (a): Median Usual Intakes from Food Alone, United States (NHANES III or CSFII)

	Men				**Women**			
	19-30	**31-50**	**51-70**	**≥71**	**19-30**	**31-50**	**51-70**	**≥71**
Energy (kcal)*	2718	2476	2109	1773	1757	1659	1507	1356
Protein (g)*	101.0	97.0	85.0	71.0	62.0	64.0	60.8	55.2
(% energy)*	15.1	15.8	16.3	16.2	14.4	15.6	16.4	16.5
Carbohydrate (g)*	331	297	255	222	229	210	191	178
(% energy)*	49.8	48.9	49.0	50.9	52.8	51.3	51.5	53.1
Fibre (g)*	17.4	17.9	17.5	16.5	12.1	13.1	13.8	13.3
Fat (g)*	100.0	93.0	79.0	65.0	63.0	61.0	55.0	48.0
(% energy)*	32.6	33.7	33.7	33.0	32.1	32.8	32.2	31.6
Saturates (g)*	34.2	31.4	25.6	21.3	20.9	20.3	17.3	15.4
Monounsaturates (g)*	38.7	36.0	30.4	25.0	24.0	23.2	20.5	18.2
n-6 polyunsaturates (g)*	16.7	16.1	14.5	11.6	11.2	11.1	10.5	8.9
n-3 polyunsaturates (g)*	1.69	1.77	1.63	1.33	1.20	1.22	1.19	1.02
α-linoleic acid (g)*	1.59	1.63	1.47	1.19	1.11	1.13	1.08	0.91
Cholesterol (mg)*	323	324	295	248	199	206	195	178
Thiamin (mg)	1.78	1.75	1.63	1.56	1.45	1.41	1.38	1.38
Riboflavin (mg)	2.09	2.03	1.87	1.84	1.63	1.60	1.58	1.60
Niacin (mg)	25.3	25.12	22.56	20.79	19.69	19.84	19.20	18.78
Vitamin B6 (mg)	2.02	1.96	1.77	1.72	1.54	1.53	1.51	1.53
Vitamin B12 (μg)	5.22	5.20	5.10	4.99	4.77	4.84	4.80	4.74
Vitamin C (mg)	114	108	103	99	79	85	97	100
Calcium (mg)**	954	857	708	702	612	606	571	517
Iron (mg)	17.90	17.90	16.80	15.50	12.20	12.10	12.00	12.30
Magnesium (mg)**	328	329	295	275	205	229	231	206
Phosphorus (mg)**	1613	1484	1274	1176	1005	990	966	859
Zinc (mg)	14.80	14.20	13.10	11.40	9.20	9.30	8.80	8.20

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1. All data were originally presented in the Dietary Reference Intake nutrient reports (IOM, 1997, 1998, 2000, 2001, 2002). Data were adjusted using the Iowa State University Method to obtain usual intake distributions. Data on folate are not shown because U.S. data were collected prior to the fortification of the food supply with folic acid. Note that niacin data are expressed in mg rather than Niacin Equivalents.

* CSFII data, 1994-6, 1998

** CSFII data, 1994

Appendix R (b): Median Usual Intakes from Food Plus Supplements, United States (NHANES III or CSFII)[1]

	Men				Women			
	19-30	**31-50**	**51-70**	**≥71**	**19-30**	**31-50**	**51-70**	**≥71**
Thiamin (mg)	1.87	1.89	1.78	1.69	1.56	1.58	1.54	1.53
Riboflavin (mg)	2.21	2.17	2.03	1.97	1.75	1.77	1.77	1.77
Niacin (mg)	26.52	27.37	24.26	22.43	21.09	21.70	21.15	20.54
Vitamin B6 (mg)	2.13	2.16	1.97	1.87	1.68	1.73	1.75	1.77
Vitamin B12 (µg)	5.40	5.45	5.48	5.19	5.04	5.20	5.12	4.97
Vitamin C (mg)	127.1	121.3	123.5	118.0	90.1	102.3	123.7	119.2
Iron (mg)	18.55	18.90	17.89	16.74	12.97	13.08	13.06	13.21
Zinc (mg)	15.34	14.77	13.90	12.12	9.64	10.08	9.52	8.92

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1. All data were originally presented in appendices of the dietary Reference Intake nutrient report (IOM, 1997, 1998, 2000, 2001, 2002). Data were adjusted using the Iowa State University Method to obtain usual intake distribution. Data on folate are not shown because U.S. data were collected prior to the fortification of the food supply with folic acid. Usual intake data were not available from the combination of food plus supplements for calcium, magnesium or phosphorus.

Appendix S

Food Sources of Selected Nutrients

Appendix S: Food Sources of Selected Nutrients

Nutrient	Meat and Alternates	Milk Products	Vegetables & Fruit	Grain Products	Other Foods
Vitamin B6 (Pyridoxine)	Meats, especially organ meats, fish, legumes		Green leafy vegetables, banana, carrot, potato, sweet peppers	Whole grains, wheat germ	Nutritional yeast
Vitamin B12	Meats, especially organ meats, eggs, fish, shellfish	Cheese, yogurt			Separable meat, meat fats, meat gravies, malted milk, meat broth soups
Vitamin C (Ascorbic Acid)			Fruits, especially citrus fruits & juices, kiwi strawberries, cabbage, tomato, potato, broccoli sweet peppers		
Folic Acid	Liver legumes		Green leafy vegetables, asparagus, banana, strawberries, orange juice	Whole grains, fortified flours, breads, pasta, rice, fortified cereals	Nutritional yeast
Calcium	Oysters, scallops, salmon and sardines with bones, tofu made with calcium, almonds	All	Green leafy vegetables, broccoli, figs, fortified orange juice		Blackstrap molasses
Iron	Meats, liver, eggs, shellfish, nuts, sardines, legumes		Broccoli, peas, prunes, raisins, dates, figs	Enriched cereals wheat germ	Blackstrap molasses
Magnesium	Nuts, legumes	Yoghurt	Peas, spinach	Whole grains, brown rice	
Zinc	Meat, liver, eggs, shellfish, legumes nuts, peanut butter	Cheese		Whole grains, wheat germ	

Source: Adapted from B.C. Dietitian's and Nutritionists' Association. Manual of Nutritional Care, 4th Edition, 1992

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